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Volume I

# FULLY PROCEDURALIZED JOB PERFORMANCE AIDS:

## VOLUME I—DRAFT SPECIFICATION FOR ORGANIZATIONAL MAINTENANCE

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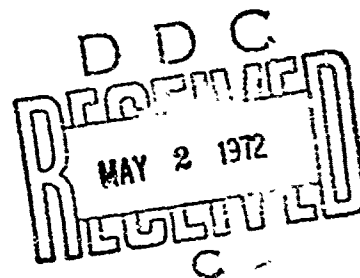
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VOLUME I

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**Volume I**

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**VOLUME I—DRAFT SPECIFICATION  
FOR ORGANIZATIONAL MAINTENANCE**

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## FOREWORD

This report represents a consolidation of advances in the development the technology of job performance aids for organizational maintenance made by the Advanced Systems Division of Air Force Human Resources Laboratory under Project 1710, "Training for Advanced Air Force Systems", and under Project 1127, "Vietnamese Air Force (VNAF) Job Performance Aids". This report provides specification and necessary guidance for multisource procurement of fully proceduralized job performance aids for organizational maintenance of Air Force systems for use in future exploratory, advanced and engineering development efforts and provides a model for the preparation of official military specifications for this type of data.

The specifications presented in this report were adopted from Mil-J-83302, Job Performance Aids Advanced-Type for VNAF Organizational Maintenance, as a model for procuring job performance aids for USAF systems. Mil-J-83302 was produced as part of Project 1127 by Applied Science Associates, Inc., Valencia, Pa. under contract F33657-71-C-0279 with the Aeronautical Systems Division. The specifications apply the findings of previous studies of performance aiding sponsored by the Advanced Systems Division under contracts AF33(615)-1137, AF33(615)-3699, F33615-68-C-1479, F33615-68-C-1527 and F33615-70-C-1500 with Applied Science Associates, Inc. and sponsored by the Aeronautical Systems Division under contract F33657-70-C-0773 with XYZYX Information Corporation, Canoga Park, California. Work on Mil-J-83302 was begun in September 1970 and completed in December 1970. Work on the adaptation was begun in September 1971 and completed in December 1971.

Dr. John D. Folley, Jr. of Applied Science Associates, Inc. was the principal investigator. Mr. Reid P. Joyce was the project director. Dr. John P. Foley, Jr. of the Advanced Systems Division was the Task Scientist and Major Jay B. Day of the Aeronautical Systems Division was the contract monitor. Mil-J-83302 was adopted for this technical report by Donald L. Thomas of the Advanced Systems Division, AFHRL (TRT).

The report was submitted by the authors in December 1971.

The technical report has been reviewed and approved.

GORDON A. ECKSTRAND, Ph.D.  
Chief, Advanced Systems Division  
Air Force Human Resources Laboratory

## ABSTRACT

This report supplies a model for specifications for the preparation of Fully Proceduralized Job Performance Aids for the operational maintenance of Air Force man-machine systems. The model reflects the research findings of AFHRL and other DOD agencies concerning maintenance data. It has the unique feature of requiring that certain subproducts necessary for the development of this type of data be prepared in a standard format and submitted for review by the procuring agency. These subproducts include items such as a task identification matrix, task inventory, a task description index and management matrix, and task step data details. The aids to be developed from these specifications are for the organizational maintenance of any man-machine system and support the performance of the following maintenance functions: checkout, alignment, repair, adjustment, calibration, malfunction isolation and the removal and replacement of malfunctioning equipment items. It calls for the preparation of the aids in several options of job guide format.

## SUMMARY AND CONCLUSIONS

### PROBLEM:

A series of research efforts conducted by the Air Force Human Resources Laboratory has resulted in the development of a new type of maintenance data known as fully proceduralized job performance aids (JPAs). Available evidence suggests that the application of fully proceduralized JPAs to the maintenance of Air Force systems will significantly increase maintenance effectiveness. A series of well defined procedures has been developed for the preparation of the aids. The use of these procedures is critical to the development of effective JPAs. Therefore, it is essential that a contractor producing JPAs be required to follow these procedures. To do this, a specification establishing the procedures to be used in developing JPAs, as well as the final product, was needed. In addition, instructional materials were needed to provide guidance for persons preparing JPAs in accordance with the specification.

### APPROACH AND RESULTS:

As an approach to the problem, the materials presented in this three volume technical report were developed to provide specifications and guidance for the development of fully proceduralized job performance aids. Volume I provides a draft specification for procurement of JPAs, Volume II provides guidance for JPA developers, and Volume III provides guidance for Air Force data managers charged with the responsibility for monitoring the development of JPAs.

The present volume, Volume I, provides draft specifications for the development of fully proceduralized JPAs for the organizational maintenance of man-machine systems. It requires the development of JPAs for all maintenance activities performed at the organizational level. These include remove, replace, checkout, align, adjust, service, and troubleshooting activities. The specification differs from most specifications in that it requires that certain procedures be used and that certain subproducts be produced in the development of the JPAs. The most important of these is the maintenance task analysis. The procedures and subproducts are required to insure that the contractor follows the JPA methodology and for updating the JPAs at a later date.

The draft specification contained in this volume was adopted from Mil-J-83302, Job Performance Aids, Advanced Type, for USAF Organizational Maintenance (USAF). The draft specification differs from Mil-J-83302 in the following ways:

1. A different format for the presentation of troubleshooting frames has been provided. This format is made optional for maintenance instruction frames. Additional format changes (page size, front matter requirements, etc.) were made as necessary to conform to the requirements of Mil-M-38784.



2. The requirement for bilingual presentation (English-Vietnamese) has been deleted.

3. The specifications for the preparation of troubleshooting decision aids have been deleted.

#### CONCLUSIONS:

This report provides draft specifications for the production of fully proceduralized JPAs for the organizational maintenance of USAF systems.

The specifications stress the necessity of a maintenance task analysis including the preparation of certain subproducts and intermediate products.

This summary was prepared by Donald L. Thomas, Training Technology Branch, Advanced Systems Division, Air Force Human Resources Laboratory.

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## SECTION I

### INTRODUCTION

For a number of years the Air Force Human Resources Laboratory has conducted a research program investigating methods of improving maintenance data. This research has given special attention to the improving maintenance effectiveness by improving the quality of the maintenance data provided to the technician. The goal has been to develop maintenance data which will enable inexperienced personnel to perform maintenance tasks at a level of proficiency approaching that of personnel who are experienced in performing these tasks. This research has resulted in the development of a type of maintenance data called fully proceduralized job performance aids (JPAs). Available evidence indicates that these aids may meet this goal.

Fully proceduralized job performance aids have several advantages over conventional technical orders. Available evidence suggests that the use of the aids may improve maintenance effectiveness by:

1. Increasing the reliability of the performance of complex maintenance tasks.
2. Greatly reducing training time.
3. Decreasing dependency upon personnel of extremely high aptitude
4. Reducing manpower requirements.
5. Facilitating the transfer of maintenance personnel from a system to a different system.

Fully proceduralized job performance aids are step-by-step instructions for performing any maintenance task that the technician may be assigned. The step-by-step instructions are accompanied by detailed illustrations which show the technician what the components referred to in the instructions look like and where they are located on the equipment. The aids are designed to provide the technician with all of

the information, in one place, that he needs to do the job and in effect "tell him every move to make". The basic concept underlying JPAs is that it is possible to simplify a job and reduce the cognitive skills required to accomplish it by "doing much of the technicians work for him in advance" through a detailed task analysis. Normally when a technician is assigned to do a task he must decide what tools to use, what actions he must take to do the job and in what sequence to perform the actions. In the development of fully proceduralized JPAs, the task analyst makes these decisions for the technician and incorporates them into the instructions. The technician does not have to generate the information himself. As a result, a less skilled, less highly trained individual can perform the job. A second advantage to this procedure is that the task analyst is in a position where he has all of the necessary information available, has adequate time to consider all possible procedures, and is better able to select the best or optimum procedure.

#### PURPOSE OF THIS TECHNICAL REPORT

Since the effectiveness of the JPAs is dependent upon the quality of the information developed and the decisions made during the task analysis, it is essential that the task analysis be of the highest possible quality. AFHRL research has developed well defined procedures for performing the analysis and for converting the results into fully proceduralized JPAs. Although portions of these procedures have been described in various technical reports, a systematic presentation of the requirements and procedures for developing the aids has not been readily available. This technical report has been prepared to meet this need. The report consists of three volumes:

Volume I - Draft Military Specification for Organizational Maintenance. This volume presents a draft specification for use in the procurement of fully proceduralized JPAs for the organizational maintenance of Air Force man-machine systems. It provides detailed requirements for the content and format of JPAs and specifies that certain procedures be utilized in preparing the aids. The specification differs from most military specifications for maintenance data in that it specifies that certain procedures be used and that certain subproducts be produced. The procedures and subproducts are required to insure that the contractor

follows the JPA methodology and to facilitate the updating the JPAs when required. The specifications provided in this volume were adapted from Mil-J-83302 (USAF), Job Performance Aids, Advanced Type for VNAF Organizational Maintenance.

Volume II - Developer's Handbook. This volume provides detailed instructions on the procedures used to develop fully proceduralized JPAs in accordance with the draft specification (Volume I). It is designed to serve as a basic guide for persons engaged in the preparation of fully proceduralized JPAs and as a sourcebook for personnel preparing programs to train personnel to develop JPAs. The materials presented in this handbook were adapted from the handbook, Handbook for Development of Advanced Job Performance Aids (JPA) in Accordance with Mil-J-83302 (USAF).

Volume III - Data Manager's Handbook. This volume provides detailed guidance for data managers and other personnel charged with the responsibility for procuring fully proceduralized JPAs. It outlines basic procedures to be used by data managers to insure that high quality JPAs are produced. The materials presented in this handbook were adapted from the handbook, Handbook for JPA Managers on Review and Assessment of Advanced Type Job Performance Aids Prepared to Mil-J-83302.

#### RELATIONSHIP TO MIL-J-83302 (USAF)

The draft specification presented in this volume was adapted from Mil-J-83302 (USAF), Job Performance Aids, Advanced-Type, for VNAF Organizational Maintenance. Mil-J-83302 was developed for procurement of JPAs for use by Vietnamese Air Force Personnel. It was modified as necessary to produce a draft specification suitable for procurement of JPAs for USAF systems. The following modifications were made:

1. The requirement for bilingual presentation (English - Vietnamese) has been deleted.

2. The specifications for the preparation of maintenance dependency chart based troubleshooting aids (Decision Troubleshooting Aids) have been deleted.

3. The format requirements have been modified to satisfy the requirements of Mil-M-38784, Manuals, Technical: General Requirements for their preparation. These changes involve page size, security markings, front matter requirements, etc.

4. An additional format is provided for presentation of the JPA frames. The new format presents the instructions in a flow chart format. Use of this format is mandatory for troubleshooting frames since it is more appropriate for tasks containing many branching instructions. Use of the format for the maintenance instruction frames is optional.

5. The applicability of the specification has been broadened to make it appropriate for the procurement of JPAs for the organizational maintenance of any Air Force man-machine system.

The basic requirements of Mil-J-83302 are retained in the draft specification. The requirements for the maintenance task analysis and the production of the subproducts and intermediate products are considered to be essential for the production of effective JPAs and have been retained in the draft specification. In addition, the requirements for illustrations, writing, organization of materials into sections, division into volumes, and indexing have been retained unchanged.



SECTION II

DRAFT SPECIFICATION

## Military Specification

### JOB PERFORMANCE AIDS, FULLY PROCEDURALIZED, FOR ORGANIZATIONAL MAINTENANCE

#### 1. SCOPE

1.1 This specification establishes the requirements for content and format of fully proceduralized technical data called Job Performance Aids (JPAs) for organizational level maintenance as defined in AFM 66-1. It includes requirements for intermediate data products related to JPA preparation and acceptance.

#### 2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents, of the issue in effect on the date of invitation for bids, or request for proposal, form a part of this specification to the extent specified herein.

#### SPECIFICATIONS

##### Military

MIL-M-38730	Manuals, Technical: General Requirement for Preparation of
MIL-M-38784	Manuals, Technical: General Requirements for Preparation of
MIL-P-38790	Printing Production of Technical Manuals: General Requirements for

#### PUBLICATIONS

##### Military

AFM 66-1	Maintenance Management
AFSCM 375-5	Systems Engineering Management Procedures
AF TO 00-5-1	AF Technical Order System
AF TO 00-20-5	USAF Vehicles and Base Maintenance Equipment
MIL-STD-17B-1 23 January 1963	Mechanical Symbols (Other Than Aeronautical, Aerospacecraft and Spacecraft Use)

MIL-STD-17B-2      Mechanical Symbols for Aeronautical,  
23 January 1963      Aerospacecraft and Spacecraft Use -  
Part 2

MIL-STD-806      Graphic Symbols for Logic Diagrams

2.2 Other Publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest military approved issue in effect on date of invitation for bids, or request for proposal shall apply.

USAS Y14.15      Electrical Diagrams

USAS Y32.2      Graphic Symbols for Electrical  
and Electronic Diagrams

USAS Y32.16      Electrical and Electronic Reference  
Designations

### 3. REQUIREMENTS

3.1 Use of Color. The use of any color except black is explicitly prohibited.

#### 3.2 Maintenance Task Analysis

3.2.1 Task Data Coverage. Task analyses shall be prepared in accordance with the requirements of 3.2 for all maintenance functions performed at the organizational level of maintenance for all subsystems.

3.2.2 The following subproducts shall be prepared in accordance with the requirements specified herein:

- a. Task Identification Matrix (TIM)
- b. Task Inventory
- c. Task Description Index and Management Matrix
- d. Test Equipment and Tool Use Document
- e. Task-step Data Details

3.2.3 Data Sources. The following types of documentation shall be consulted in preparation of the maintenance task analyses. The most recent issues at the time the task analysis is performed shall be used.

##### 3.2.3.1 New Systems. These documents are defined in AFSCM 375-1.

- a. Functional Flow Block Diagram
- b. Requirement Allocation Sheet (RAS)
- c. Trade Study Report
- d. Time Line Sheet
- e. Schematic Block Diagram
- f. Design Sheet
- g. Facility Interface Sheet

- h. End Item Maintenance Sheet (Manual)
- i. Maintenance Sheets (Automated)
- j. Maintenance Loading Sheet
- k. Maintenance Ground Equipment (MGE)  
and Aerospace Ground Equipment (AGE)
- l. Personnel Utilization Sheet
- m. Calibration Requirements Summary

3.2.3.2 Existing Systems. The following data sources in addition to those specified in 3.2.3.1 shall be used when maintenance task analysis is undertaken on systems that are in the operational phase.

- a. Technical Orders (TOs)
- b. Engineering Reports
- c. Standard Operating Procedures (SOPs)
- d. End Item Parts Inventories
- e. Special Tools and Test Equipment Manuals
- f. Illustrated Parts Breakdown (IPB)
- g. Other Drawings; e.g., photographs, engineering drawings, etc.
- h. Field Data; Maintenance technicians experienced in the maintenance of end items at the organizational level shall be consulted in the preparation and verification of the maintenance task analysis. In addition, maintenance operations on the end items shall be observed as necessary if other data sources are inadequate.

3.2.4 Duplication of Effort. The preparation of maintenance task analyses to support job performance aid development shall not result in duplication of effort. Valid data which have already been prepared as part of system development shall be used where available and applicable. The data shall be incorporated in the task analysis by reference.

3.2.5 Use of Computer. The use of a computer for data storage and retrieval is acceptable. Data formats specified in this section (3.2) may be modified for computer use so long as the information requirements and deliverable data requirements of this specification are met.

3.2.6 Task Identification Matrix. A Task Identification Matrix (TIM) shall be prepared in accordance with the following requirements:

3.2.6.1 Hardware Entries. The item entries for the matrix (i.e., row headings) shall be obtained from the sources identified in 3.2.3 and formatted in accordance with the instructions below. Hardware-related terms shall be used as defined in 6. NOTES.

3.2.6.2 Hardware Formats and Codes. The names for subsystem, equipment, group, etc., items shall be entered in the rows of the TIM as illustrated in the example in Figure 1. A unique code designation shall be assigned to each row entry. A numerical code is illustrated in Figure 1 and may be used as guidance. In this code, each hardware item is assigned a number which uniquely identifies the item by name and level. Eight fields are provided in this code, each field corresponding to a level in the hardware end item hierarchical lists.

Maintenance Functions System Hardware Levels	1	2	3	4	...	13
	Adjust	Align	Calibrate	Checkout	...	Troubleshoot
12. Landing gear subsystem						
.						
.						
13. Communication subsystem	0	0	0	TL		0
13.1. Transmitting station	0	0	0	TL		0
13.1.1. Modulation equipment	0	0	0	TL		T
13.1.1.0.1. Power Supply	0	0	0	TH		0
13.1.1.0.2. Mod Unit	0	0	0	0		0
13.1.1.0.2.1. Speech amp	0	0	0	0		T
13.1.1.0.2.2. FSK	0	0	0	0		T
13.1.2. Transmitting set	0	0	0	T		0
13.1.2.1. Transmitter	0	T	0	0		0
13.1.2.1.1. Osc	T	0	0	0		T
13.1.2.1.1.1. SMO	T	0	0	0		0
13.1.2.1.2. Driver	T	0	0	0		T
13.1.2.1.2.1. Malt	0	0	0	0		0
13.1.2.1.3. P.A. unit	0	T	0	0		T
13.1.2.1.3.1. Buffer	T	0	0	0		0
13.1.2.1.3.2. P.A.	T	0	0	0		0
13.1.2.1.3.2.0.1. Parts	0	0	0	0		0
13.1.2.2. Antenna group	T <sub>5</sub>	0	0	0		0
13.1.2.2.0.0.0.1. Parts	0	0	0	0		0
13.2. Receiving Station	0	0	0	TL		0
13.2.1. Receiving set	0	0	0	TL		0
.						
.						
13.2.2.0.2. TT printer	T	0	0	0		0
14. Navigation and recognition subsystem						
.						
.						
30. Airborne monitor and recording subsystem						

Figure 1. Sample Task Identification Matrix

The code assigned to a hardware item shall reflect its position of subordination in the hardware top-down-breakdown. The actual hardware subordination shall dictate the code level assigned to an item rather than the traditional definition of "equipment group" etc.

3.2.6.3 Maintenance Function Entries (i.e., column headings). The following terms shall be used as defined in 6.2:

- a. Adjust
- b. Align
- c. Calibrate
- d. Checkout
- e. Handle
- f. Inspect
- g. Install
- h. Operate
- i. Remove
- j. Repair
- k. Service
- l. Troubleshoot

3.2.6.4 Maintenance Function Formats and Codes. The names for the maintenance functions shall be entered in the column headings for the TIM, as illustrated in Figure 1.

The names for each of the maintenance functions shall be assigned a code, such as the numerical one indicated in Figure 1.

3.2.6.5 Task Cell Entries. For each intersection within the matrix the following types of entries shall be made as appropriate:

- ( - no organizational maintenance task of this type is performed on this end item.
- T - organizational maintenance tasks of this type are performed on this end item. Indicate more than one task in a cell by a subscript that shows the number of tasks.
- T<sub>H</sub> - a task identified at this end item level is part of a task performed at some higher level in the end item list. For example, a checkout task identified at the equipment level may be a subroutine within a subsystem checkout or be an integral part of it.
- T<sub>L</sub> - the maintenance function at this end-item level is made up of tasks performed at lower levels in the end item list. For example, a checkout at the equipment level may be made up of individual checkout tasks at the unit level.

3.2.6.6 Review and Approval. The Task Identification Matrix shall be submitted for review and approval by the Procuring Agency. The approved TIM shall define the population of tasks which require the preparation of job performance aids. Subsequent additions to, or deletions from, this task population may be initiated by either the contractor or the Procuring Agency, but shall be approved by the Procuring Agency.

3.2.7 Task Inventory. The JPA contractor shall prepare a Task Inventory consisting of the list of all tasks performed at the organizational level on the end items in the Task Identification Matrix.

3.2.7.1 Task Statement Formats and Codes. Each task statement shall be made up of the name and code of one end item combined with one maintenance function name and code from the Task Identification Matrix. To the nine-field code for the end item and maintenance functions, a tenth field shall be added for the task statements. Figure 2 indicates how this may be done. Use of the ten-field code permits each task statement to be assigned a unique number.

3.2.7.2 Review and Approval. The Task Inventory shall be documented as a working paper by the JPA contractor and made available for review by the Procuring Agency.

3.2.8 Task Description Data Base. The JPA contractor shall either collect or generate, as required, task description data for each of the tasks in the Task Inventory. The task description data base is composed of the materials prepared in accordance with paragraphs 3.2.9 through 3.2.10.

3.2.9 Test Equipment and Tool Use Form. This document provides detailed information on the use of test equipment and tools in conducting maintenance tasks. It shall be prepared by the JPA contractor in accordance with the requirements which follow.

3.2.9.1 Each item of test equipment and each special tool used in any maintenance task shall be listed. A special tool is any tool not in the mechanic's normal tool kit, as defined by the Procuring Agency.

3.2.9.2 All functions for which each test equipment or special tool is used in performing the maintenance tasks in which they are used shall be listed opposite the name of each item.

3.2.9.3 Opposite each function shall be listed the classes of specific information to be included in the JPA whenever any of these functions occurs in a task. The initial determination of what information is to be included will be made by the contractor on the basis of information provided by the procuring agency about the capabilities of the expected users of the JPA. The kind and level of detail of the information shall be such that a typical user would be able to follow the instructions and perform the function, but shall be such that information the

System (not including)	Subsystem	Equipment	Group	Unit	Assembly	Subassembly	Stage	Part	Maintenance Function	Task Statement	Task Name
13	00	00	00	00	00	00	00	04	01	Checkout communication subsystem	Checkout communication subsystem
13	00	00	00	00	00	00	00	08	01	Operate communication subsystem	Operate communication subsystem
13	01	00	00	00	00	00	00	04	01	Checkout transmitting station	Checkout transmitting station
13	01	00	00	00	00	00	00	08	01	Operate transmitting station	Operate transmitting station
13	01	01	00	01	00	00	01	09	01	Remove Spark Plug #1	Remove Spark Plug #1
									02	Remove Spark Plug #2	Remove Spark Plug #2
									03	Remove Spark Plug #3	Remove Spark Plug #3
									04	Remove Spark Plug #4	Remove Spark Plug #4
etc.											

Figure 2. Examples of Task Statements and Codes



user can reasonably be expected to know at the time of task performance is not included in the JPA. Figure 3 illustrates properly prepared entries on the Test Equipment and Tool Use Form.

3.2.9.4 Review and Approval. The test Equipment and Tool Use Form shall be submitted to the Procuring Agency, as directed, for review and approval.

3.2.10 Task Description Index and Management Matrix. This document shall be in the general format illustrated in Figure 4 and shall contain the following information.

3.2.10.1 Row Headings. The task statements and codes of the Task Inventory shall be entered as row headings in the matrix in the same order as listed in the Task Inventory.

3.2.10.2 Column Headings. The columns of the matrix shall be headed by the types of data required for each task as specified in 3.2.10.3. These headings shall be arrayed in the order listed in 3.2.10.3.

3.2.10.3 Specific Task Description Data Required. The following information shall be entered or referenced for each task on the matrix under the column headings as indicated. Entries shall be in accordance with 3.2.10.4.

a. Equipment Description and Operation (Column A). The applicable sections of Technical Orders and other system documents which describe the physical characteristics and the mode of operation for the item of equipment on which the task is performed shall be identified and referenced.

b. Equipment Drawings (Column B). The applicable drawings in Technical Orders and other system documents which illustrate the location of the items of equipment within the aircraft on which the task is performed shall be identified and referenced. These include: 1) general aircraft locators, 2) specific aircraft locators, 3) item enlargements, and 4) exploded drawings.

c. Equipment Configuration Applicability (Column C). The applicability of the Task data to various equipment configurations (MIL-M-38730). If the data applies to all configurations, the word "all" shall be entered. Any unique or distinguishing features among aircraft series shall be identified and described.

d. Test Equipment and Special Tools (Column D). The test equipment and special tools required for task performance shall be identified. A separate Test Equipment and Tool Use Form (3.2.9) shall be prepared to provide the required information. References shall be made in the matrix to the applicable sections of this document.

Name and Number of the Item	Functions	Information about Uses to be Included In Job Performance Aid
Oscilloscope 545A	Measure	<ol style="list-style-type: none"> <li>1. All scope control settings.</li> <li>2. Step-by-step procedure.</li> <li>3. Illustration of proper waveform.</li> <li>4. Computation formula showing what readings to enter.</li> </ol>
Torque Wrench	Tighten fasteners to specified torque	<ol style="list-style-type: none"> <li>1. Illustration of wrench.</li> <li>2. Illustration of range setting.</li> <li>3. Illustration of wrench in position.</li> <li>4. Illustration of pointer indicating proper torque.</li> </ol>

Figure 3. Sample Test Equipment and Tool Use Form

Task Analyst _____ Page No. _____					
Task Inventory  Task Statements & Codes	Task Description Content Categories	A  Equipment Description & Operation	B  Equipment Drawings	C  Equipment Configuration Applicability	M
				.....	Notes

Figure 4. Sample of Task Description Index and Management Matrix

e. Supplies (Column E). The expendable items and support materials shall be identified. Sealants, lubricants, replacement lamps, and "maintenance in progress" tags are examples of expendable items. The Federal Stock Numbers shall be included when available. The quantity and size of each expendable item shall be included with the list of items. Codes shall be developed for these items so that they can be employed to update the Job Guides.

f. Personnel Required (Column F1). The minimum number of technical personnel required to perform the maintenance task shall be identified. Each of these technicians shall be identified by job title and level(s). The specific task steps that each must perform shall be identified and keyed to the task step narrative descriptions in Column K2. The locations of each of the technicians when performing the task shall be identified; e.g., Technician A is in the cockpit, Technician B is on the ground at the tail of the aircraft, etc. The communication requirements between technicians shall also be indicated, including the method of communication, the information exchanged, and the task steps at which the exchange takes place. The latter data shall be keyed to the task steps in Column K2 in the matrix.

g. Specialists Required (Column F2). The requirements for specialists to perform a task, or task steps, or to assist the maintenance technicians in performing a task shall be identified. The specialists shall be identified by job title and level(s). The tasks or task steps which they are required to perform and the communication requirements between the specialist and maintenance technician shall be identified and inserted or referenced in Column F2 of the matrix. References to task steps are to be keyed to Column J2.

h. Equipment Condition (Column G). The state or condition of equipment that must exist before the task is performed shall be stated. For example, an aircraft must be on hydraulic jacks before removing the shock strut.

i. Notes, Cautions, and Warnings (Column H). All notes, cautions, and warnings that apply to the entire task shall be identified as specified in MIL-M-38784.

j. Replacement Parts and Illustrated Parts Breakdown (Column I). For those tasks which require replacement parts, these parts shall be identified by name and number. In addition, the applicable figure in the Illustrated Parts Breakdown shall be referenced by Technical Order number and volume, figure number, and title.

k. Forms (Column J). Any forms that the technician must fill out (such as inspection reports, trouble reports, and maintenance logs), shall be identified. Each reference shall include form number and title, and the source of instructions for filling it out (e.g., AFTO-00-20-5).

1. Task Initiation (Column K1). The contractor shall provide the following data related to the factors which require that a task be performed:

(1) Whether the task is 1) initiated on a scheduled basis such as the result of performing a preventive maintenance (PM) routine, or 2) performed as a result of a write-up by the pilot or other crew member which describes some malfunction that the flight crew has discovered, or 3) discovered to be needed, as a result of performing other tasks (such as inspection or checkout tasks). The precise basis for task initiation shall be identified, such as the malfunction symptoms identified by a flight crew member or the schedule (e.g., daily, monthly, etc.) which is to be followed.

(2) Whether the task being analyzed is normally initiated as a result of performing some prior task, or set of tasks; i.e., is it a part of a sequence or a branching from other tasks? The prior task (which should also appear in the Task Inventory) shall be identified by name and code.

m. Task Steps (Column K2). If detailed descriptions of task steps are available in documents, and if the analyst is assured that the descriptions validly represent the steps, and if the information meets the requirements set forth below, then he shall reference the documents, which thus become part of the Referenced Data Base. If the steps are not adequately documented, the contractor shall develop the required data in accordance with the following requirements, and reference to this Created Data shall be entered in Column K2 of the matrix. Special requirements for developing task steps for troubleshooting tasks are specified in 3.4 and 3.5.

(1) The task steps shall be arranged in the order in which they are performed.

(2) Any requirements for the specific timing of task steps shall be identified.

(3) Verbs shall be selected from the standard verb list (See 6.2)

(4) The level of detail with which the task steps are described shall be based on information about the skill and knowledge capabilities of the user population, as determined in accordance with 3.2.11.

n. Tolerances (Column K3). Task steps which require the adjustment, alignment, or calibration of an equipment item to a specified numerical tolerance shall be identified, and the numerical values shall be entered or referenced to the appropriate task step in Column K2 of the matrix. Measures shall be expressed in units appropriate to the equipment item involved; e.g., use decimal units with feeler gauges.

o. Specific Notes, Cautions, and Warnings (Column K4). Specific notes, cautions, and warnings shall be referenced to the step to which they apply.

p. Repetition (Column K5). Task steps which are repeated, such as adjustment of several identical items of equipment, shall be identified, and the requirements for such repetitions shall be entered or referenced into the step or steps to which they apply.

q. Multiple Technicians/Specialists (Column K6). Any references to multiple technician or specialist requirements (identified in Columns F1 and F2 of the matrix) shall be referenced in Column K6 for the step or steps to which they apply. The same entry that appears in Columns F1 and F2 will be repeated in Column K6.

r. Maintenance Support Information (Column K7). Any additional instructions that are required for performing the task that are not appropriate for inclusion as instructions in the job guides shall be identified and referenced.

s. Special Instructions and Standard Operating Procedures (Column K8). Those tasks which require special instructions, such as how to perform a dye penetrant test, or which consist of standard operating procedures (SOPs) shall be identified and the source of such instructions referenced or the data entered.

t. Follow-On Tasks (Column K9). Those tasks which are not complete work units in themselves and therefore require the performance of an additional task(s) (i.e., follow-on maintenance) to return the aircraft or subsystem to a ready state or to a safe condition shall be identified and the task or task alternatives which follow shall also be identified. The names and codes for such follow-on tasks shall be entered.

u. Task Repetition (Column K10). Those tasks which are repeated on different equipment items or at different times on the same equipment item shall be identified and the requirements for such repetition entered or referenced. If there are any variations between the original and repeated performances of task, these shall be identified.

v. Task Termination (Column L). The indication of task completion shall be specified in the following terms to the extent that they apply:

- (1) A given unit of activity is completed, such as the completion of a specific type of maintenance function (e.g., an equipment item is removed, or the results of performing a checkout task have been obtained).
- (2) The system is no longer in a "down" condition.
- (3) The aircraft or subsystem is not left in a condition that is dangerous to equipment or the user.

(4) Performance of the last task step results in a decision point, at which the maintenance technician must decide on the appropriate next task to be performed.

w. Notes (Column M). The task analyst shall note any information in this column on the matrix form that is pertinent to understanding and interpreting information in any of the other columns.

3.2.10.4 Matrix Cell Entries. The cell entries in the matrix shall be as follows:

- 0 - task description category is not relevant to the particular task statement.
- ? - insufficient information has been collected for the formulation of a cell entry.

Data - short data entries may be inserted directly into the appropriate cell in the matrix. Such data are part of the Created Data Base.

References - if the data are not entered in the matrix, a reference to where the data are stored (either the Referenced or Created data bases) shall be made. This reference shall be sufficiently specific that, in the case of data which are to be inserted directly into a job aid, the formatter is able to determine precisely which data are relevant. This may require referencing to the level of specific sentences or drawings in some cases.

3.2.10.5 Review and Approval. The Task Description Index and Management Matrix shall be submitted for in-process review and comment as directed by the Procuring Agency. The Matrix shall not be considered complete until entries have been provided in all information categories for each item in the Task Inventory. When the matrix is complete it shall be submitted for review and final approval by the Procuring Agency.

3.2.11 Task-step Data Details. The level of detail of task description data shall be such that after it is put into proper job guide format, a member of the user population at the tenth percentile of that population in maintenance skills and knowledges shall be able to follow the job guide and perform the task correctly.

In order to help ensure that this standard is met, the JPA contractor shall submit for review and approval, as required by the Procuring Agency, a statement of the kind of information he will include in the narrative task data for each of the following types of task actions:

3.2.11.1 Discrimination and Perceptions Critical to Successful Job Performance. These include:

- a. Observing gross indications, such as a light on or off, or a meter reading in or out of the acceptable band.

- b. Reading quantitative values, such as voltages or pressures on meters and gauges.
- c. Noting relative motion between components, such as the actuation of mechanical linkages.
- d. Reading or interpreting scope patterns or wave forms.
- e. Noting defects by physical signs, such as worn surfaces, vibration, etc.
- f. Presence or absence of distinctive sounds.
- g. Discrimination of a particular characteristic of sound, such as normal versus abnormal bearing whine.
- h. Discrimination of proper pitch or frequency.
- i. Discriminations of odors such as from overheated bearings or burned insulation.

3.2.11.2 Problem Solving and Decision-Making Critical to Successful Task Performance. These include:

- a. Selection of appropriate next step or task to be performed where there are alternatives.
- b. Performing calculations.
- c. Exercising judgment.
- d. Translations or converting data, such as from binary to decimal, etc.

3.2.11.3 Motor Actions Critical to Task Performance. These include:

- a. Activating binary switches, such as push buttons, toggle switches, etc.
- b. Adjusting continuous controls to specified settings, as the adjustment of voltage levels on a scope.
- c. Setting a multi-position control to a specified setting, such as the selection of a voltage scale on a scope.
- d. Performing coordinated gross body movements, such as required in positioning an item of hardware for installation.

### 3.3 Job Guides

3.3.1 Coverage. Job Guides shall be prepared to support all organizational maintenance tasks identified in 3.2. (Maintenance Task Analysis as requiring JPA coverage, with the exception of troubleshooting tasks.)



3.3.2 Types of Job Guides. The following types of job guides shall be prepared:

- a. Maintenance Instruction Manual
- b. Index to Maintenance Instruction and Inspection Guideline Manuals
- c. Inspection Guideline Manual
- d. Maintenance Support Information Manual

3.3.3 Maintenance Instruction Manual

3.3.3.1 Contents. Maintenance Instruction Manuals shall contain illustrated, step-by-step instructions for the performance of the following maintenance functions (as defined in 6.2) on applicable hardware items at the organizational level:

- a. Adjust
- b. Align
- c. Calibrate
- d. Checkout
- e. Handle
- f. Inspect
- g. Install
- h. Operate
- i. Remove
- j. Repair

3.3.3.2 Volumes, Division Into. There shall be at least one volume for each aircraft subsystem (e.g., propulsion, electrical, instruments). Each volume shall be limited in size to 300 pages (150 sheets). Each volume shall be identified by an Arabic number. Each volume shall contain a cover, a title page, a list of effective pages, a table of contents, and one or more sections.

3.3.3.3 Sections. Each section shall bear a title which describes an activity. Each activity shall consist of a single maintenance task or a group of tasks all related to a higher-order maintenance function, such as checking or adjusting a number of similar hardware items (e.g., flight instruments or door hinges). Each section shall contain: (a) an Input Conditions page, (b) Replacement Parts pages, (when required), and (c) pages of instructions and illustrations. Sections shall be numbered consecutively within a volume, and pages shall be numbered consecutively within sections (e.g., the second section of a volume shall begin with page 2-1).

3.3.3.4 Input Conditions Page(s). This page shall be the first page of each section. All the information required to prepare for the activity contained in the section shall be contained in the input conditions page. See Figure 5 for format. The following items shall be included in the input conditions page.

T.O. JPA IH-1(u)H-2-17	T.O. JPA IH-1(u)H-2-17
REMOVE AND INSTALL TAIL ROTOR PITCH CONTROL QUILL AND ROD	REMOVE AND INSTALL TAIL ROTOR PITCH CONTROL QUILL AND ROD
INPUT CONDITIONS	ACTIVITY INDEX
<u>Applicable Serial Nos:</u>	<u>Procedure</u> <u>Page</u>
All UH-1H aircraft	Replacement Parts 3
<u>Special Tools and Test Equipment:</u>	Depressurize Hydraulic System 5
One Maintenance Support Information Manual	Remove (All Components) 7
One tensiometer	Open Vertical Fin Tail Rotor Shaft Access Door 7
One torque wrench, calibrated in inch-pounds	Tail Rotor Crosshead Assembly 9
One 10-pound weight	Sprocket Cover, Sprocket Guard, Silent Chain and Tail Rotor Control Pan 11
One feeler gage	Tail Rotor Pitch Control Quill and Rod 13
<u>Supplies:</u>	Install (All Components) 15
One Maintenance in Progress tag	Inspect Tail Rotor Pitch Control Quill and Rod 15
One Circuit Breaker label	Pitch Control Sprocket, Retaining Nut, Pitch Control Rod, O-Ring and Tail Rotor Control Pan 17
<u>Install:</u>	Retaining Plate and Bearing Set 19
Grease, MIL-G-25537	Crosshead Shim and Crosshead 21
<u>Personnel Required:</u> Two	Adjust Pitch Control 29
Assistant will be required in forward cabin.	
Specialist will be required to connect external hydraulic power to aircraft upon request.	
4-1	4-2

Figure 5. Example of Format for Input Conditions Pages

a. Activity Title. The name of the activity shall appear in capital letters at the top of the page. Activity titles shall specify the type of maintenance to be performed (e.g., remove, install, adjust) and the hardware item that is to receive the maintenance.

b. Applicable Serial Numbers. Applicability of the instructions to various equipment configurations shall be stated in accordance with MIL-M-38784. If the instructions apply to all configurations, the word "all" shall be entered.

c. Special Tools and Test Equipment. All maintenance tasks (e.g., install, remove) requiring tools or test equipment not included in technicians' tool kits shall be identified. The special tools and/or test equipment needed for the performance of such maintenance shall be listed (including the quantity of each) beneath the name of the appropriate task. Common name, specific name, and part number shall be noted. When tasks require a Maintenance Support Information Manual, the volume number of the manual shall be listed here.

d. Supplies. Expendable items and support materials shall be listed. Sealants, lubricants, replacement lamps, labels, "maintenance in progress" tags, etc., are considered expendable items. When the item can be identified by a Federal Stock Number, the number shall be given. The quantity and size, when applicable, of each expendable item required to complete the task shall be given.

e. Personnel Required. The minimum number of personnel required to perform the task shall be stated. The number may include the primary technician and one or more assistants (to whom verbal instructions will be communicated by the primary technician), or several technicians for whom individual instructions are provided separately in the manual. Following the statement of number of personnel shall be statements of the task starting position (relative to the system) of each technician and assistant. Technicians shall be designated Man A, Man B, etc.; assistants shall be designated "Assistant". Finally, if any specialists are required for such activities as piloting the aircraft or connecting external electrical or hydraulic power, such a requirement shall be stated, e.g., "Specialist will be required to operate electrical power cart." Specialists shall not be included in the number of personnel required to perform the task.

f. Equipment Conditions. Certain activities are dependent upon the system being in a given condition (e.g., aircraft must be on hydraulic jacks before removing the shock strut). These required conditions shall be stated. Any information pertinent to safety shall also be included and presented as a caution or warning. When the required conditions can be obtained by performing other organizational maintenance tasks, those tasks shall be indicated as prerequisites and shall be referenced by volume and page number.

g. Warnings, Cautions, Notes. Any Warnings, Cautions, or Notes applicable to the entire task shall be included as specified in MIL-M-38784.

h. Activity Index. The activity index shall be a listing of all maintenance tasks that are performed during the activity and the corresponding page numbers on which they start. In addition, a reference to the appropriate page(s) for a list of applicable Replacement Parts shall be included on the left side under the heading, Procedure. The corresponding page numbers shall be on the right side under the heading, Page.

3.3.3.5 Replacement Parts Pages. When replacement parts are required by an activity, Replacement Parts pages shall follow the Input Conditions page, and shall contain the following:

On the left page: activity title; identification of the applicable Illustrated Parts Breakdown (IPB) or equivalent and applicable figure within same; and relationship of part name (and illustration callout) to item number in the applicable IPB or equivalent.

On the right page: an illustration, usually an exploded view, with callouts to each hardware item included in the list on the facing page. See Figure 6 for format.

3.3.3.6 Maintenance Instruction Frame. The frame is the basic unit of maintenance instruction information presentation. A frame shall consist of two facing pages, with step-by-step narrative instructions on one page and associated illustrations on the facing page.

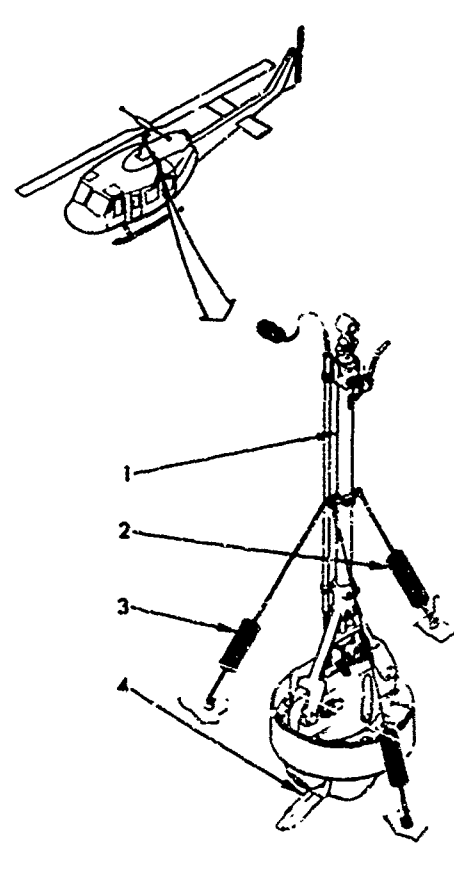
a. Narrative Instruction Page. This page shall consist of a group of task steps which are to be performed in an indicated order. The nomenclature for each hardware item mentioned in the body of the task steps shall be accompanied by a callout number, in parenthesis, keyed to an illustration of that item appearing on the facing pages. The writing shall be in accordance with 3.3.7.3. The following types of task step and information paragraphs shall be used as needed:

(1) Linear Task Step - Linear task steps are task-steps which are performed in a fixed sequence (i.e. task step x is always followed by task step y).

(2) Branching Task Step - Branching task steps contain measurement or observation procedures which, by its outcome, determines the next task step to be performed (i.e. step x may be followed by step y or step z depending upon the results of the check at step x). When a test instrument is involved, the name of the instrument and the type of measurement to be made shall be included in the instruction.

T.O. JPAIH-1(u)H-2-5		T.O. JPAIH-1(u)H-2-5	
REMOVE, INSTALL AND SERVICE EXTERNAL CARGO SUSPENSION		<input type="radio"/>	<input type="radio"/>
<u>Replacement Parts:</u>			
Refer to applicable Organiza- tional Maintenance Repair Parts and Special Tools List:		<input type="radio"/>	<input type="radio"/>
TM55-1520-210-20P			
Figure 449		<input type="radio"/>	<input type="radio"/>
<u>Part</u>	<u>Item Nos.</u>		
External suspension (1)	53		
Restraint spring (3)	56		
Restraint spring (2)	57		
Restraint spring (5)	56		
Figure 452			
<u>Part</u>	<u>Item Nos.</u>		
Cargo hook (4)	53	<input type="radio"/>	<input type="radio"/>
		<input type="radio"/>	<input type="radio"/>
		<input type="radio"/>	<input type="radio"/>

1-3



1-4

Figure 6. Example of Format for Replacement Parts Pages

(3) Reference Paragraph - Reference paragraphs direct the technician to branch to a specific page or frame of the JPA.

(4) Notes, Cautions, and Warnings Paragraphs - These paragraphs contain comments that emphasize important and critical conditions to which the technician should attend, as well as the corresponding action implications. The requirements of MIL-M-38784 are applicable.

(5) Terminal - Task steps which complete the maintenance activity.

b. Illustration Page. The page facing the maintenance instructions shall contain an illustration of every hardware item to which reference is made in the instructions. Illustrations shall be in accordance with 3.3.7.4.

c. Format. The frame may be printed in either of two optional formats. The format to be used will be established by the procuring agency. Option I is recommended for most procurements. The optional formats are:

(1) Format Option I: The frame shall be printed horizontally on two facing pages. The right-hand page shall contain the step-by-step instructions in flow chart form. The left-hand page shall contain the supporting illustrations. Linear task steps, notes, cautions and warnings shall be outlined by a single line, one point thick (see Figure 7A). All other task-steps shall be indicated by 20-30 percent fine screen (85 lines/inch) background (see Figure 7B). Branching frames shall use windows in the screen background (see Figure 7C) to indicate expected readings and tolerance or to indicate the reason for branching (e.g. to branch to the correct instruction for aircraft with a specified serial number). In order to show the prescribed sequence of task steps,

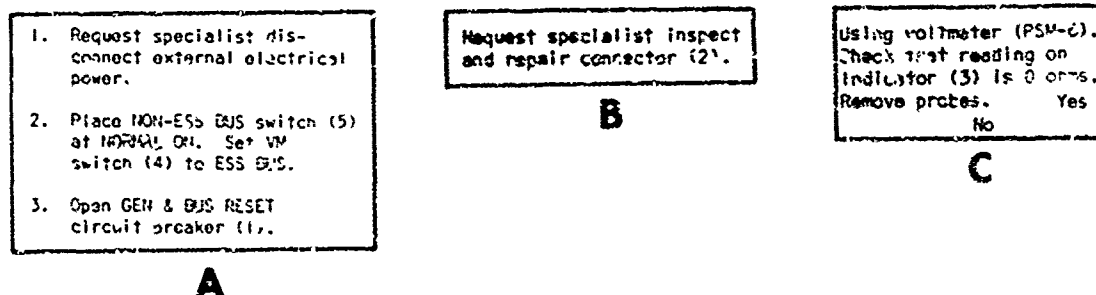


Figure 7. Sample Task-Step Formats

the task steps shall be interconnected by arrows. The major procedure flow line, which runs on from page to page, will be of three point thickness. The arrows that flow to reference or terminal frames shall be one point in thickness. See Figure 8 for an example of a frame presented in this format.

(2) Format Option II: The frame shall be printed vertically on two facing pages with the step-by-step instructions on the left-hand page and the associated illustrations on the right-hand page. The task steps shall be presented and numbered in the sequence in which they are to be performed. The numbering of the steps shall begin with one on each page. See Figure 9 for an example of a frame presented in this format.

3.3.4 Index Manual. There shall be at least one index volume for each series of Maintenance Instruction Manuals, i.e., for each major system (aircraft, missile, etc). Each volume shall be limited in size to 300 pages (150 sheets). The index volume shall be Volume 1 of the Maintenance Instruction Manual series. If the index is contained in more than one volume, the volumes shall be numbered 1.1, 1.2, etc.

3.3.4.1 Content. The index manual shall provide systematized reference information to all activities included in the Maintenance Instruction Manuals.

3.3.4.2 Organization. Three index listings shall be provided:

- a. Major Subsystem Listing
- b. Equipment Alphabetical Listing
- c. Line Removable Items Alphabetical Listing

3.3.4.3 Major Subsystem Listing. Each major subsystem of the system shall be numbered as a section within the Index Volume. The sections (subsystem names) shall be arranged alphabetically and numbered consecutively from one.

- a. Within each section the pages shall be numbered consecutively from one (e.g., the first page of the second section would be numbered 2-1).
- b. Within each section the major subsystem shall be divided into equipments. These equipments shall be arranged alphabetically.
- c. Each equipment shall be divided into Line Removable Items, which shall be arranged alphabetically.
- d. Under each LRI shall be listed the titles (arranged alphabetically) and volume and page numbers of all maintenance tasks performed upon that item.

3.3.4.4 Equipment Alphabetical Listing. Equipments which have a maintenance activity performed upon them shall be presented in alphabetical order. Beneath each equipment shall be given the

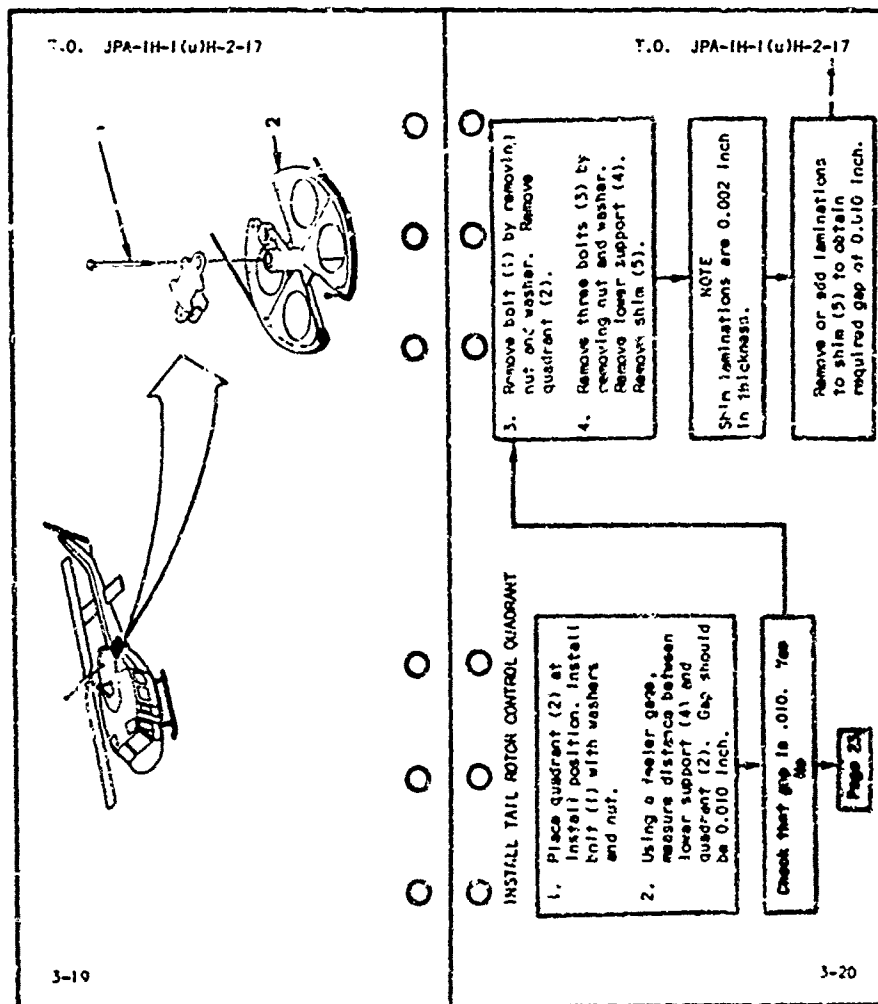


Figure 8. Example of Format for Maintenance Instruction Frame presented in Accordance with Option I



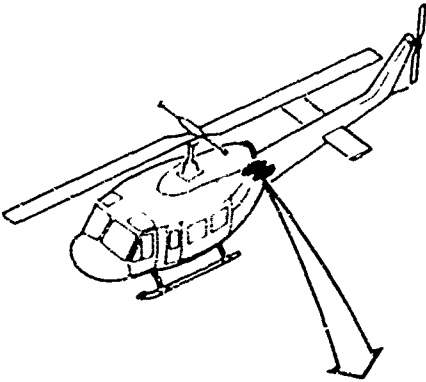
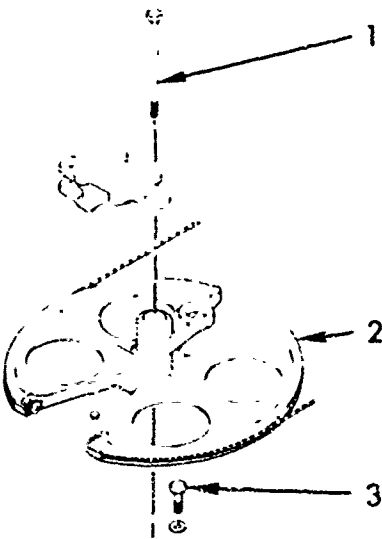
<p>T.O. JPA-IH-1(u)H-2-17</p> <p>INSTALL TAIL ROTOR CONTROL QUADRANT</p> <ol style="list-style-type: none"> <li>1. Place quadrant (2) at install position. Install bolt (1) with washers and nut.</li> <li>2. Using a feeler gage, measure distance between lower support (4) and quadrant (2). Gap should be 0.010 inch.</li> </ol> <p>NOTE</p> <p>If gap is 0.010 inch, go to Page 23.</p> <ol style="list-style-type: none"> <li>3. Remove bolt (1) by removing nut and washer. Remove quadrant (2).</li> <li>4. Remove three bolts (3) by removing nut and washer. Remove lower support (4). Remove shim (5).</li> </ol> <p>NOTE</p> <p>Shim laminations are 0.002 inch in thickness.</p> <ol style="list-style-type: none"> <li>5. Remove or add laminations to shim (5) to obtain required gap of 0.010 inch.</li> </ol>	<p>T.O. JPA-IH-1(u)H-2-17</p>  
--	---

Figure 9. Example of Format for Maintenance Instruction  
Frame Printed in Accordance with Option II

titles and locations (volume and page number) of applicable maintenance tasks. This listing shall be numbered as a section of the manual (3.3.4.3).

3.3.4.5 LRI Alphabetical Listing. LRIs which have a maintenance task performed upon them shall be presented in alphabetical order. Beneath each equipment shall be given the titles and location (volume and page number) of applicable maintenance tasks. This listing shall be numbered as a section of the manual (3.3.4.3).

### 3.3.5 Inspection Guidelines Manual

3.3.5.1 Content. The Inspection Guidelines Manual shall contain illustrated step-by-step instructions for the following types of maintenance (as defined in T.O. 00-20-5):

- a. Preflight Inspection (for aircraft)
- b. Basic Post-flight Inspection (for aircraft)
- c. Phased Inspection
- d. Periodic Inspection

The following types of maintenance shall also be included as required, as part of the instructions for the above types of maintenance:

- a. Ground Handling. Ground handling shall include such activities as towing, hoisting, jacking, mooring, and parking.
- b. General Service. General service shall include such activities as lubrication, cleaning, fueling and defueling, and paint touch-up.

3.3.5.2 Special Page Requirements. All requirements for front matter, Input Conditions Page, Replacement Parts Page, and Maintenance Instruction Frame are identical to those stated in 3.3.7.2 and subparagraphs thereto.

3.3.5.3 Volumes, Division Into. There shall be at least one volume for each of the types of maintenance listed in 3.3.5.1. Each volume shall be limited in size to 300 pages (150 sheets). The volumes shall be identified by consecutive Arabic numbers in the same series as the Maintenance Instruction Manuals. Each volume shall contain specified front matter (3.3.7.2) and one or more sections.

3.3.6 Maintenance Support Information Manual. There shall be at least one such volume for each series of Maintenance Instruction Manuals, i.e., for each aircraft. Each volume shall be limited in size to 300 pages (150 sheets). The manual will be volume 2 of the Maintenance Instruction Manual series.

3.3.6.1 Contents. This manual shall contain, but shall not be limited to, the following types of information:

a. General system information (dimensions, stations, access, inspection openings, walkways, etc). This information shall include brief descriptions of the system, its purpose, dimensions, capabilities, main functions, and subsystems. Information shall be presented in the form of charts and tables where appropriate.

b. Ground support equipment descriptions.

c. Standard maintenance procedures.

d. Other support information whose format may not be compatible with the standard Job Guide presentation.

3.3.6.2 Ground Support Equipment Data. Descriptions of all types of ground support equipment used in organizational maintenance of the subject system shall be included in this section, together with instructions for their use. These instructions shall include all applicable Notes, Cautions, and Warnings, in accordance with MIL-M-38784.

3.3.6.3 Standard Maintenance Procedures. This section shall describe, in job guide format supplemented with pictorials, applicable general maintenance tasks such as:

- a. Hookup of electrical power
- b. Techniques for lockwiring
- c. Rig pin insertions
- d. Cotter pin insertion
- e. Hydraulic power hookup, and
- f. Cockpit opening and closing

3.3.6.4 Other. Other types of information which may be included in the Maintenance Support Information Manual are:

- a. Lubricants, description and uses
- b. Torque-tolerance data tables
- c. Applicable standards and specifications
- d. Part identification information
- e. Tables of measures and conversion equivalents

3.3.6.5 Format. The JPA contractor shall recommend a format for approval by the Procuring Agency. The recommended format shall be generally consistent with other formats specified in this section 3.3.

### 3.3.7 General Requirements for Job Guides

3.3.7.1 Page Size. The Job Guides, Indexes and Maintenance Support Information Support Manuals shall be printed on 4 by 8 inch paper, with an image area of 3-1/2 by 7-1/2 inches. See Figures 10 and 11 for page layouts.



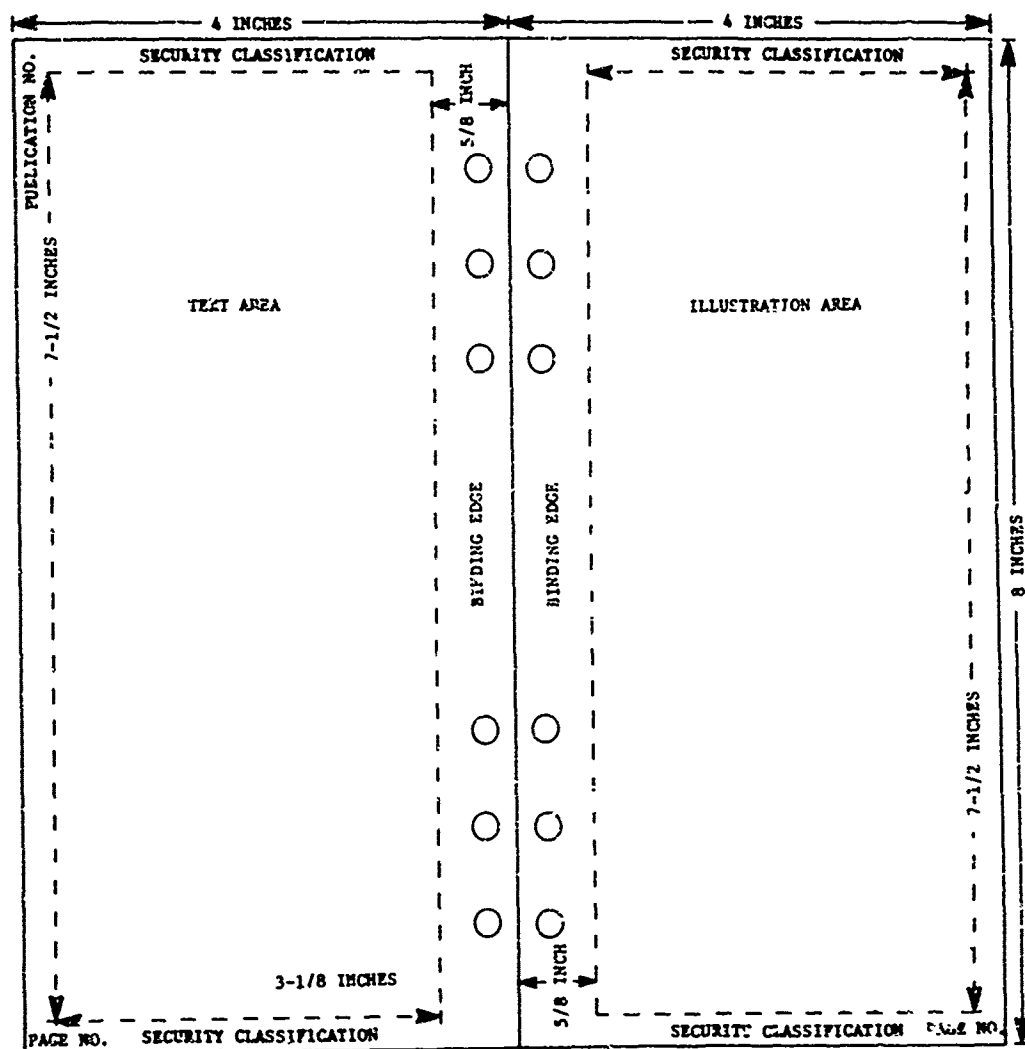


Figure 11. Page Layout for Option II

3.3.7.2 Front Matter Requirements. The following front matter and format requirements apply to all job guides.

a. Title Page. The information on the front cover shall be as specified in MIL-M-38784. The type of job guide (e.g., maintenance instructions, inspection guide, etc.) and the major subsystem covered shall be included in the title. See Figures 12 and 13 for sample title pages.

b. List of Effective Pages. The requirements of MIL-M-38784 are applicable.

c. Table of Contents. The table of contents shall be presented in column form printed vertically on the page. The major subsystem being addressed shall be specified, e.g., electrical. Each activity included within the manual shall be listed. The number of the start page of each activity shall appear to the right of the name of the activity. Beneath each activity (with the exception of OP CHECK), there shall be a list of all tasks addressed in the text of the manual for that activity. The wording of the names of the tasks listed in this section shall be identical with the wording used within the text. To the right of the listed task, there shall be the section and page number on which it appears. See Figure 14 for format. The pages of the Table of Contents shall be numbered consecutively in lower-case Roman numerals, beginning with i.

### 3.3.7.3 Writing Requirements

a. Mood. The second person imperative shall be used for maintenance instructions. The third person indicative shall be used for description and discussion statements. For example, "Torsion link assembly transmits torsional loads from axle to shock line". The second person imperative mood is common language, telling the technician what to do, e.g., Set POWER switch to ON. Articles shall be excluded for brevity. The third person indicative mood shall be used primarily in Notes, Cautions, and Warnings. An example is "Man A starts at flight station and goes to cargo compartment".

b. Sentence Structure. The elements of a sentence should be arranged generally in the following order: 1) subject, 2) verb, 3) object, 4) predicate object, 5) indirect object.

(1) Subject. Implicit only, except when more than one technician is required.

(2) Verb. Select from verb list that work (or phrase) which best describes the technician's behavior with respect to the object.

(3) Object. The specific equipment to which the technician's behavior is directed.

T.O. JPA-1H-1(u)H-2-21

## **TECHNICAL MANUAL**

Job Performance Aid

# **ORGANIZATIONAL MAINTENANCE INSTRUCTIONS PROPULSION**

USAF SERIES  
UH-1H  
HELICOPTER

Published under authority of the Secretary of the Air Force

15 AUGUST 1970

Figure 12. Sample Title Page for Job Guides

T.O. JPA-1H-1 (u)H-2TS-21

**TECHNICAL MANUAL**

*Job Performance Aid*

**PROCEDURALIZED  
TROUBLESHOOTING AID  
PROPULSION**

USAF SERIES  
UH-1H  
HELICOPTER

*Published under authority of the Secretary of the Air Force*

15 AUGUST 1970

Figure 1.3. Sample Title Page for Fully Proceduralized Troubleshooting Aid



T.O. JPA-1H-1(u)H-2-4	
Table of Contents	
Airframe	
	Page
Inspect Windshields and Windows	1-1
Remove and Install Windshield and Door Upper window	2-1
Remove and Install Pilot's or Copilot's Door Adjustable Window	3-1
Remove and install Cabin Roof Window	4-1
Remove and Install Cabin Nose Window	5-1
Remove and Install Cargo Door Windows	6-1
Operational Check Pilot's and Copilot's Windshield Wipers	7-1
Remove and Install Windshield Wiper and Motor-Converter	8-1
Left-hand Headguard Bracket	
Right-hand Headguard Bracket	
Left-hand Motor Converter	
Right-hand Motor Converter	
Windshield Wiper Arm	

Figure 14. Example of Format for Table of Contents

(4) Predicate Object. The term (or terms) which qualify the condition of the object (may not always be necessary).

(5) Indirect Object. The location of the object (not preferred over pictorials to give such information).

Example:

(Subject)- understood (verb) Attach (object) maintenance in progress tag to (predicate object) pilot's cyclic stick. This sentence reads: Attach maintenance in progress tag to pilot's cyclic stick.

or

(Subject) Man A (verb) sets (predicate object) MASTER switch to (predicate object) NORM position on (indirect object) IFF control panel. This sentence reads: Man A sets MASTER switch to NORM position on IFF control panel.

When a special tool is called out as part of a step, the step statement shall be preceded by the word, "using", and the tool name. For example, Using (tool name) snap-ring pliers (step statement), pull bushing from hinge. This sentence reads: Using snap-ring pliers, pull bushing from hinge.

c. Verb List. Verbs used in any instruction shall be selected from the standard verb list in 6.2. All proposed changes to the list shall be reviewed and approved by the Procuring Agency.

d. Noun/Object List. In addition to standard noun lists provided by the Procuring Agency, a noun/object list shall be developed by the contractor and approved by the Procuring Agency. Nouns used in any instruction shall be selected from the approved list.

e. Nomenclature. Consistency shall be maintained between the first and subsequent occurrences of each item of nomenclature in a frame. The nomenclature for an equipment item shall be used in full on its first appearance in the frame. On subsequent occurrences, if there is no other name with which it might be confused, the nomenclature may be shortened. For example, the frequency track or test switch may be called the track or test switch, test switch or simply switch if no other switch has been mentioned or illustrated in the same frame. Simple identifying nomenclature may be provided for attaching parts in text, such as, "lower attaching bolts". Nomenclature corresponding to that appearing on the equipment in decals, engraved legends, nameplates, or other markings shall be stated

in the text: exactly as it appears on the hardware, on the first occurrence. All hardware items involved in a task shall be specifically mentioned. Nomenclature containing terms that refer to the purpose, functions, or nature of an item, and that are irrelevant to the task requirement shall not be used. For instance, the spoiler center wing input quadrant need not be called such in an instruction to insert a rig pin. The presence of an illustration showing the location of the unit enables the instruction to be written simply: "insert rig pin in quadrant", or "insert rig pin." Modifiers are required only when two or more items of the same nomenclature are acted upon in the same task.

f. Capitalization. The following words and items shall be capitalized: NOTE, CAUTION, WARNING, INPUT CONDITIONS, SPECIAL INSTRUCTIONS, END OF SPECIAL INSTRUCTIONS, END OF ACTIVITY, activity title, component names, and control and display titles as engraved on the equipment. Equipment names shall not be capitalized unless they are so engraved.

g. Numbers. Numbers used in text shall be written out if one digit; if two or more digits, they shall be written as numerals (exceptions are test equipment readings and callout numbers). Equipment markings should always be written as engraved on the equipment.

h. Tolerances. When tolerances are required, the tolerances shall be written at the end of the step (torque mounting bolts to 40 pounds, plus or minus one pound). Measurements shall be written in the language of the tool used, e.g., thousandths of an inch are appropriate if the technician is to use a feeler gauge; either Hertz or graticule scale divisions may be appropriate (depending upon level of user capability) for a frequency check with an oscilloscope.

i. Switch Setting Instructions. The following conventions shall be adopted for writing instructions with switches. For switches which hold their position once they are set, write: Set (name) switch to (position). For setting several switches, begin at the top left and proceed clockwise - at a maximum of four switches per step. For springloaded switches which do not hold their position, write, (a) for a momentary setting: momentarily hold (name) switch to (position); (b) for a longer action when a specific setting is required: place (name) switch to (position) and hold until (result).

j. Follow-on Maintenance. If, upon the completion of a maintenance activity, further maintenance is required to return the aircraft to operational readiness, it shall be termed "follow-on maintenance" and treated in the following manner:

- (1) The "Maintenance in Progress" tag shall not be removed from its location.

(2) A caution in the form of the following example shall be provided, including volume, section, and page reference to the subsequent task.

CAUTION

Follow-on Maintenance Action Required:  
"Install Main Driveshaft" (Vol. 12, p. 4-27)

- k. Method for Cross-Referencing. When referring to material contained elsewhere in the Job Guides, the writer shall provide the reader with sufficient information to proceed directly to the referenced material. This shall be in the form: "Task Name" (volume-section-page). For example, "Install Main Driveshaft" (Vol. 12, p. 4-27).
- l. Number of Maintenance Steps Per Frame. There shall be no more than seven steps on each instruction frame.
- m. Composition of Maintenance Steps. Each step shall contain no more than three sentences, and no more than 25 words. Any one sentence shall contain no more than 10 words. Where possible, each step shall contain one or more references to the accompanying illustration.
- n. Method for Keying Text to Illustrations. Each time a part or location is mentioned in the text, it shall be followed (parenthetically) by a locator number (callout) on the accompanying illustration.
- o. Safety Requirements. The text shall contain Warnings, Cautions, and Notes in accordance with MIL-M-38784, on the page(s) where applicable.
- p. Energizing/De-energizing and Pressurization/Depressurization Instructions. Frames containing such instructions shall contain no other instructions.
- q. Assistants. Steps for an assistant shall all be written exactly as those for the primary technician, except they shall be introduced by the phrase, "request that assistant . . ." They shall be incorporated in procedures in places appropriate for proper coordination and smooth flow. Locator information shall be provided as necessary for assistants.
- r. Specialists. Steps for a specialist shall be written exactly as those for the primary technician, except they shall be introduced by the phrase, "request that (type of specialist, e.g., electrician . . .)". They shall be incorporated in procedures in places appropriate for proper coordination and smooth flow.
- s. Multi-man Activities. When two or more technicians must perform more than three steps, procedures shall be prepared separately for each man. Each procedure shall include all steps required on the

individual during the activity. All steps shall be written as for a solitary technician. Only those steps actually performed by the individual technician shall appear in his respective activity procedures. Man A's steps shall not be presented to Man B and vice versa, except in those cases needed to clarify coordination and communication.

The communication instruction shall pick up both men at that point in the activity where they must cooperate.

Situation 1 - When one man's step is not to be started until the second man completes a given step. A note shall be provided to the first man advising him not to start until a report is received from the second man. The second man shall be instructed to report when he completes the given step, and the instructions shall be incorporated in the step. A description of the nature of the report shall be specified for each report and each response, e.g., report when ready to observe pointer; do not start until Man A reports he is ready to observe pointer.

Situation 2 - When one man performs a given step and the second man checks the equipment response to the step. A note shall be provided to the first man not to start until the second man reports he is ready. A one sentence description of the equipment action controlled by the step shall be included. A note shall be provided to the second man indicating that the step is in response to an action by the first man and to report when ready. Instructions shall be provided telling when to report.

Situation 3 - When the cooperative step may require repetition and instructions to repeat the step cannot be condensed. A short description of the equipment response shall be provided in a note preceding the step to the man checking the equipment response. If subsequent cooperative actions are different from those in the completed action, they shall be treated the same as Situations 1 and 2. If subsequent cooperative actions are the same as those of the completed action, the ground rules for repeated steps or sequences shall be used.

c. Repeated Steps. When a step has been completed, a second or third step is accomplished, and it is then necessary to repeat the first step, a reference to the first step may be made. This method should be used when the following conditions exist:

- (1) The step does not involve danger to the technician or equipment.
- (2) The sequence of elements within the step is always the same.
- (3) The step is no longer than four elements.

(4) Not more than two steps intervene between the first and subsequent presentation of the step.

(5) No numerical reference is involved.

u. Special Instructions. A special instruction may occur when a task is repeated within a volume. To prevent the necessity for presenting the same task several times in the same volume, it may be designated (on the first occurrence) a special instruction and referenced when required. Before the special instructions may be referenced, the following conditions shall be met:

(1) Two or more steps are repeated in sequence.

(2) If reference information is used, the same reference applies to each repeat.

(3) The steps are identical except they are applicable to a different control or display.

The special instruction shall be uniquely titled. It shall be explicitly labeled "SPECIAL INSTRUCTION" and the end of the special instruction shall be denoted by the phrase "END OF SPECIAL INSTRUCTION".

The special instructions shall be referenced by: "perform special instruction title, (section number - page number)," i.e., "perform Dye Penetrant Test, (3-4)."

v. Training Note. The writer shall add, where necessary, for clarity of complex steps in a procedure, a brief description (25 words or less) of what the technician is supposed to do and how the equipment responds. This should be in the form of a Note which precedes the task the first time it is written. This is called a Training Note.

An example of a Training Note follows:

NOTE

Doppler Lock-on is indicated when indicator light goes out after ground speed is selected on simulator.

1. Set SIMULATOR GROUND SPEED selector to 200 knots. Check that Lock-on occurs within 30 seconds.

2. Check for Lock-on within 30 seconds at each of 4 other ground speeds: 240 knots, 280 knots, 320 knots, and 400 knots.

To repeat this entire task at a later time, simply write a single task step using the descriptive title:

1. Perform doppler lock-on check.

Obviously, some judgment has to be exercised in deciding when to employ a Training Note based upon whether a task is very complex or repeated often enough to make it worthwhile.

w. Activity Endings. The phrase "END OF ACTIVITY" shall appear at the end of each activity, also for each man's pages within a combined package. Within a task (e.g., remove nose cowl and seals), the phrase shall not appear between LRIs.

x. General Safety Provision. An activity ending shall not leave any portion of the aircraft in an inoperable or dangerous condition without adequate warnings being provided for all individuals likely to be affected.

y. Review. When 20-25 percent of Job Guide manual text has been written, a 10 percent sample of material prepared by each writer shall be selected at random and tested to assure: a) compliance with writing requirements; and b) that content accurately and completely reflects the information developed in the task analysis as specified herein. Evidence that this review has been performed including certification by each writer that appropriate feedback has been provided him shall be presented as a working paper to the Procuring Agency for review and approval. Approval must be obtained before 35 percent of the text is complete. Government participation in examination of materials other than the working paper shall be at the government's option.

3.3.7.4 Illustration Requirements. Only line artwork shall be prepared. Line weights shall be of sufficient density to reproduce sharply and clearly at the final reproduction size. Line artwork shall be prepared such that ozalid or equivalent copies of the original artwork can be obtained.

a. Level of Detail. The illustration page shall present only the equipment to which the actions on the facing page refer, plus sufficient surroundings to permit swift localization of the pertinent equipment item or part. If all illustrations required to support a page of text will not fit on a single page, the text must be put on two or more pages, each with its supporting illustration page.

b. General Locator. When an equipment item is first illustrated in an activity and its location has not yet been specified, a general locator illustration shall be used to identify the

location of the equipment item of concern on the system. The specific item shall be shaded black in the general view, and a locator arrow shall be drawn from the shaded area to a more detailed view. See Figure 15.

c. Specific Locator. Specific system locators shall represent satellites of the general locator and shall be located no closer than 1-1/4" from the general system locator.

d. Item Enlargement. Enlargements of hardware items shall represent satellites of the specific system locators. Item enlargements, when arranged around a specific locator, shall be spaced no closer than 3/8 inch from each other and from the specific locator. The layout shall be arranged in a planetary system with the general locator as the focal point. See Figure 16.

e. Exploded View. An exploded view may be necessary to illustrate the proper interrelationships of parts. Exploded parts shall be shown on a dashed line to indicate their actual location as shown in Figure 15.

f. Interconnecting Arrow Symbolology. Arrows leading away from the general locator to specific locators, or away from specific locators to enlarged views shall be unnumbered, tapered, with open body, and shall point to the specific locator or item enlargement. The area being enlarged, which is located at the base of the arrow, shall be shown as a solid black area on the general locator illustration. The enlarged view shall be located within 1/4 inch of the locating arrow head. Figure 15 illustrates the proper style and use of arrows with the general locator illustration.

g. Callouts. Specific features of interest shall be pointed out on the item enlargement with callout lines. No more than seven callouts shall be used on any enlargement. An arrow shall connect the callout number to the correct point on the illustration. Callouts shall be limited to only those used in the instructions on the facing page. The arrows and heads shall be paratone type 44001 or a directly interchangeable equivalent and shall point to the feature of interest, covering as little of the illustration as possible. Figure 15 illustrates the proper style and use of callouts with item enlargements.

h. Numbering of Callouts. The callouts on an illustration page shall be consecutively numbered. Callout numbers shall begin on the drawing at approximately the three o'clock point and proceed clockwise around the first functional segment enlargement and clockwise from item to item around the page.



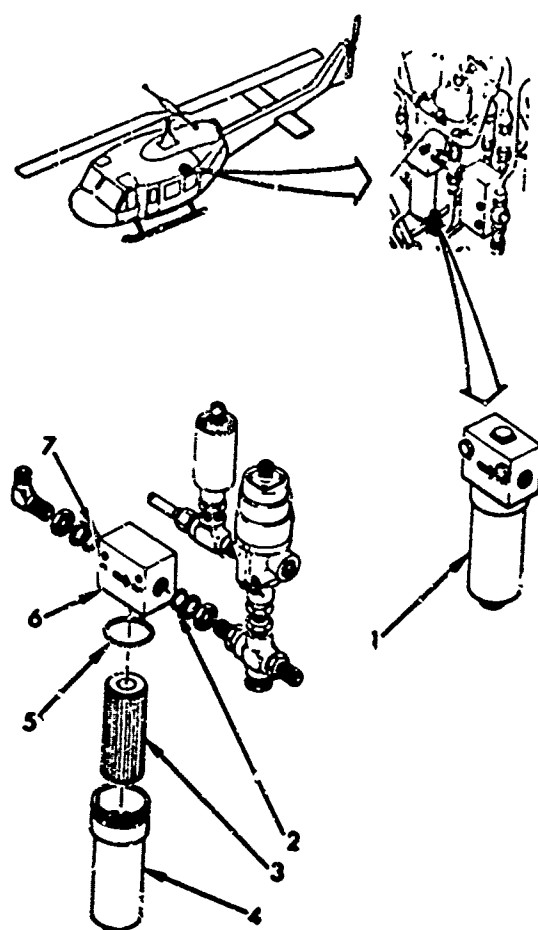


Figure 15. General and Specific Locator Illustration  
with Item Enlargement and Exploded View

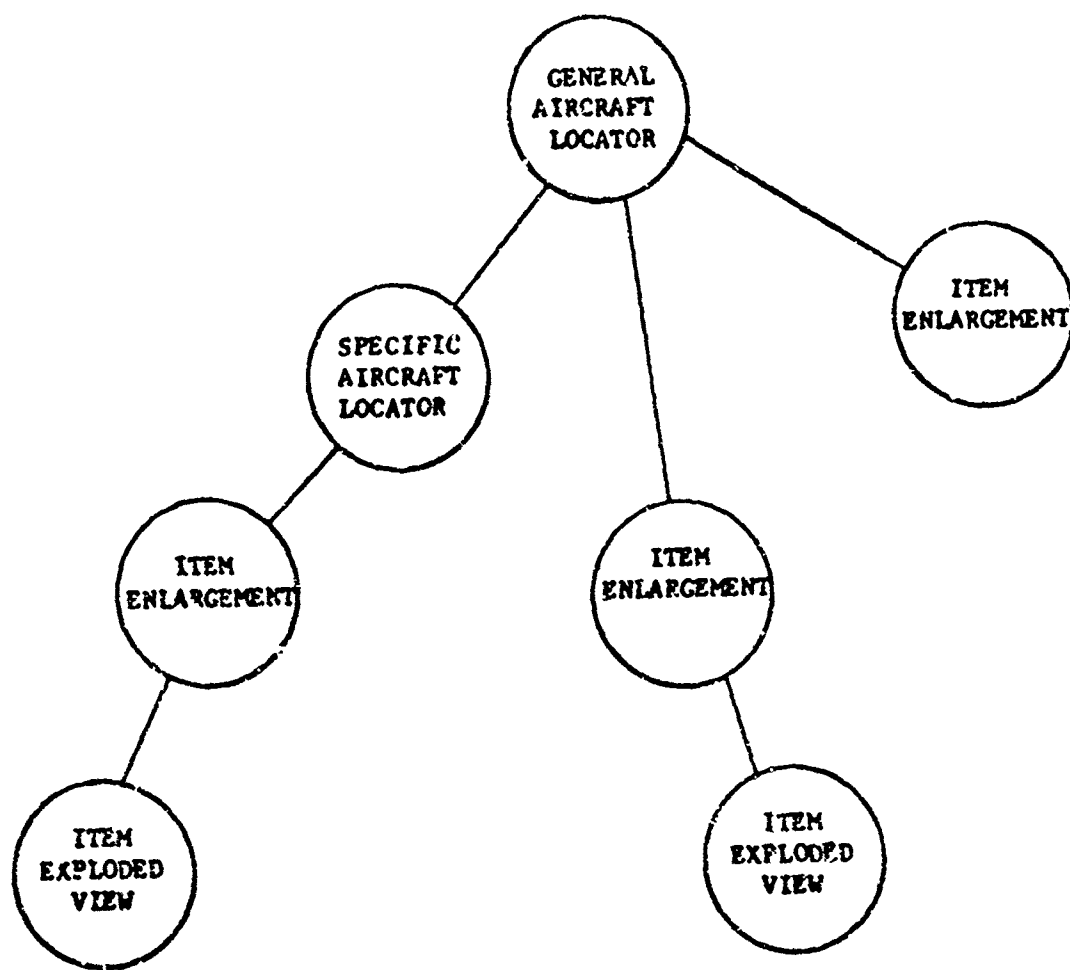


Figure 16. Planetary Locator Illustration Layout

i. Orientation Direction Arrows. Arrows indicating the line of regard with respect to the aircraft shall be included in illustrations where they may effectively substitute for general locators or where otherwise necessary.

3.3.7.5 Typography and Lettering. These shall be as stated in Table I.

3.3.7.6 Numbering of Volumes of Job Guides. Job Guide volumes shall be numbered as follows:

- |           |   |
|-----------|---|
| Volume 1. | Index manual. If more than one volume is required they shall be numbered 1.1, 1.2, etc.   |
| 2.        | Maintenance Support Information Manual. If more than one volume is required they shall be numbered 2.1, 2.2, etc.   |
| 3.-n      | Maintenance Instruction Manual. Volumes shall be numbered consecutively, e.g., 3, 4, 5, etc.  |
| n+1-N     | Inspection Guidelines Manual. Volumes shall be numbered consecutively starting with the next number in the series following the final Maintenance Instruction Manual. |

3.3.7.7 Security Classification Markings. The requirements of MIL-M-38784 are applicable.

#### 3.4 Fully Proceduralized Troubleshooting Aids

3.4.1 Coverage. Fully Proceduralized Troubleshooting Aids shall be prepared for every Troubleshooting task in the Task Inventory. (3.2.7)

3.4.2 Intermediate Products. The following intermediate products shall be prepared.

- a. List of Components and Failure Modes
- b. List of Functions
- c. List of Function Failures
- d. Functional Unit Implications of Function Failures
- e. Malfunction Symptoms
- f. Component Block Diagrams
- g. Action Trees
- h. Draft of Checkout Procedures
- i. Reading and Tolerance Data Collection Form

3.4.3 Final Products. Fully Proceduralized Troubleshooting Aids shall consist of the following two types of volumes:

Table I. Typography and Lettering for  
Job Performance Aid Pages

Use	Face and Point Size	Case
Security Classification	14 Point (Final Size) Eton BOLD or Equivalent	Upper
Figure Titles  Illustration Orientation	12 Point (Final Size) Extra Bold Sans Serif	Upper
Callout Numbers  Alphanumeric Designators (Blocked Schematic)  Block Letters Designating Paragraphs (Keyed Text)	18 Point (Final Size) Extra Bold Sans Serif	Upper
Chapter and Section Titles  Note, Caution, and Warning (Word Only)	10 Point Futura Light or Equivalent, Never Reduced More than 40 percent in Final Size	Upper
Body and All Other Written Matter and Lettering		Upper and Lower

3.4.3.1 Troubleshooting Aid Volumes. These shall contain complete step-by-step instructions and supporting illustrations for troubleshooting the subject equipment. The troubleshooting frames shall be presented in the format described as Option I in paragraph 3.3.3.6. See Figures 17 and 18 for examples of troubleshooting frames presented in this format.

3.4.3.2 Index Volume. One index volume shall be prepared, covering the Troubleshooting Aids for one system. Within this volume, troubleshooting procedures shall be indexed by subsystem (e.g., propulsion, navigation, avionics) and functional unit (e.g., gyro compass, emergency transmitter), by indicator, by lights, by circuit breakers, by sight gauges, and by malfunctions.

3.4.4 Organization. Fully Proceduralized Troubleshooting Aids for an aircraft shall be organized into a series of volumes, and the volumes into sections as specified in 3.3.3.2 and 3.3.3.3, with the following modifications:

a. All activity titles shall begin with the word "troubleshoot". (3.3.3.3)

b. There shall be no Replacement Parts page. (3.3.3.3)

3.4.5 List of Components and Failure Modes. A tentative list of all ways in which all end items in the Task Inventory can fail shall be prepared. Figure 19 shows a partially completed sample of a List of Components and Failure Modes. Requirements for preparing this list are as follows:

a. Component. This column shall contain the end items associated with "Troubleshoot" tasks in the Task Inventory. (See 3.2.7)

b. Part Number. Part numbers are the unique identification numbers assigned to components by the manufacturer of the component.

c. Stock Number. The Federal Stock Number (FSN).

d. Types of Failure Modes. This column shall contain a listing of the ways each component can fail. For example, each winding in an electric motor could be open or short, or could contain an insulation breakdown.

3.4.6 List of Functions. A List of Functions shall be prepared for each functional unit. The equipment level at which functions shall be described is between the replaceable-unit level and the subsystem level (as represented by the fuel subsystem, the propulsion subsystem, the communications subsystem, etc.). The functional units that comprise the subsystems are the ones for which functions must be described. A function is an action, operation, change of energy level, or change of energy form performed by the hardware item. For example, the function



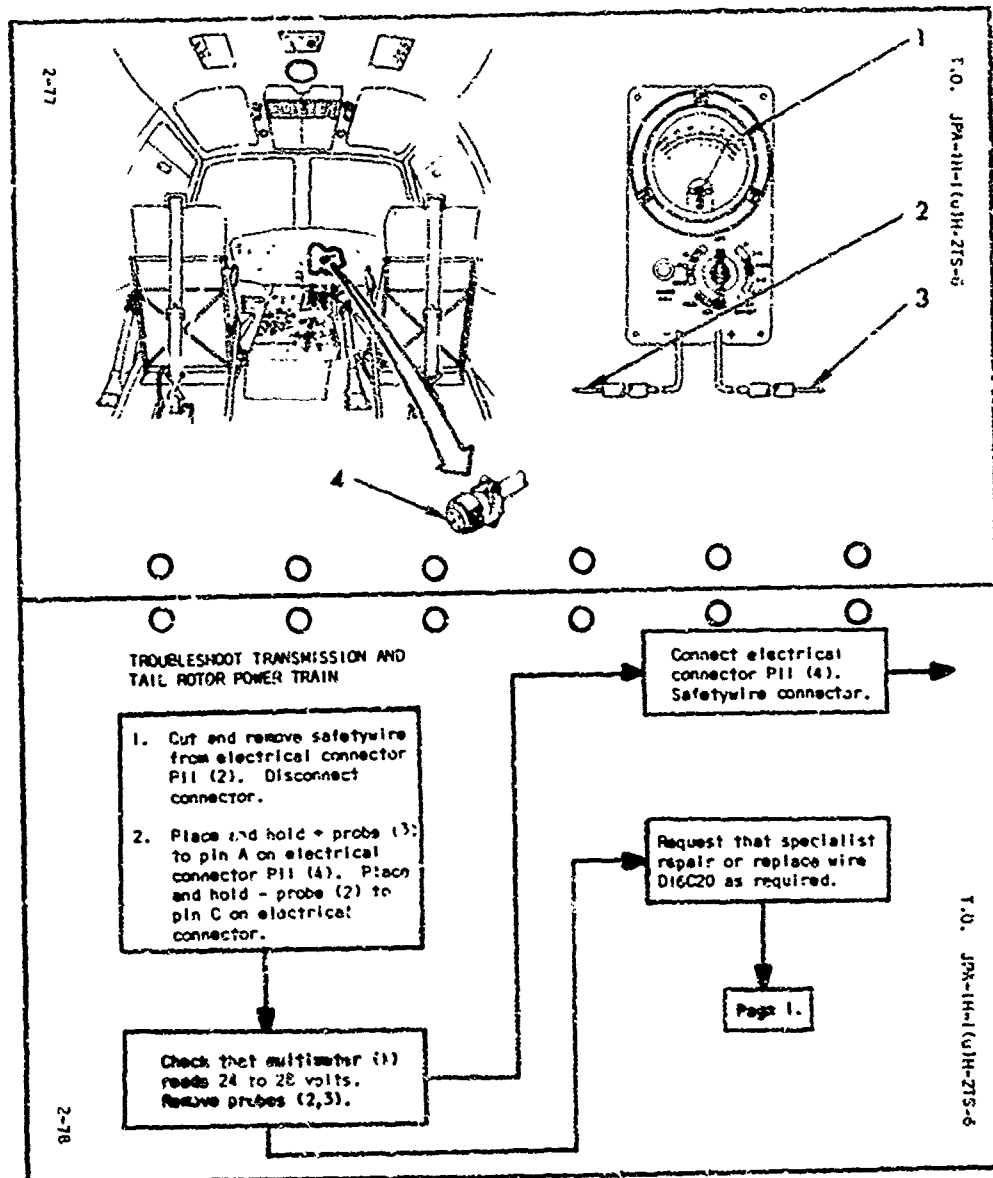


Figure 18. Example Troubleshooting Frame (from Fault Isolation Sequence)

# LIST OF COMPONENTS AND FAILURE MODES

Components	Part Number	Stock Number	Types of Failure Modes
T7901	3379-018	5576-313-2	L1; Short, open, short to gnd L2: Short, open, short to gnd

Figure 19. List of Components and Failure Modes



of a Hydraulic Pump is to increase fluid pressure in a closed system. The function of a Radio Antenna is to receive electromagnetic lines of force. The function of an electronic hardware item might be to amplify, process, or convert power supply voltages or currents.

3.4.7 List of Function Failures. For each function identified for a functional unit, a list shall be prepared of the ways the function can fail. This list shall contain a description of how the function might be performed other than in its normal fashion.

3.4.8 Detectable Indications of Function Failures. For each function failure that is identified, a list shall be prepared of the detectable indications of the failure. This list shall include all operations that could be performed to determine whether or not a function is being performed within nominal tolerances, and all indications that the function has failed (including odor, tactile, and sound cues).

3.4.9 Malfunction Symptoms. Each distinctly different set of detectable indications of function failure from 3.4.8 shall be listed.

3.4.10 Component Block Diagram. A component block diagram shall be prepared for each malfunction symptom. This block diagram shows all equipment end items that can be repaired or replaced at the organizational level of maintenance, and that could, by their failure, produce the malfunction symptom. Each such end item shall be represented by a box labeled with its designator or name. In addition to the active components, all interconnecting hardware items (e.g., wires, plugs, jacks, mechanical linkages, pipes, hoses, or ducts) shall each be represented by a box. The logic of configuration, arrangement, and connection shall be shown with lines between the boxes. The lines shall have arrowheads that show direction of flow (transmission) of data, mechanical force, electrical power or current, gas, liquid, and solid matter. However, the lines shall not represent hardware items that interconnect the more active components, since interconnecting components will all be represented by boxes.

3.4.11 Action Trees. A complete action tree (branching procedure) shall be developed for each malfunction symptom that is identified. Each tree shall consist of a group of interconnected boxes in accordance with the following requirements. (See Figure 20).

3.4.11.1 Action Tree Components. An action tree shall contain the following types of boxes:

- a. Summary box, which shall contain a statement of equipment condition and a malfunction symptom.
- b. Repair or Replace box, which shall contain the following information:

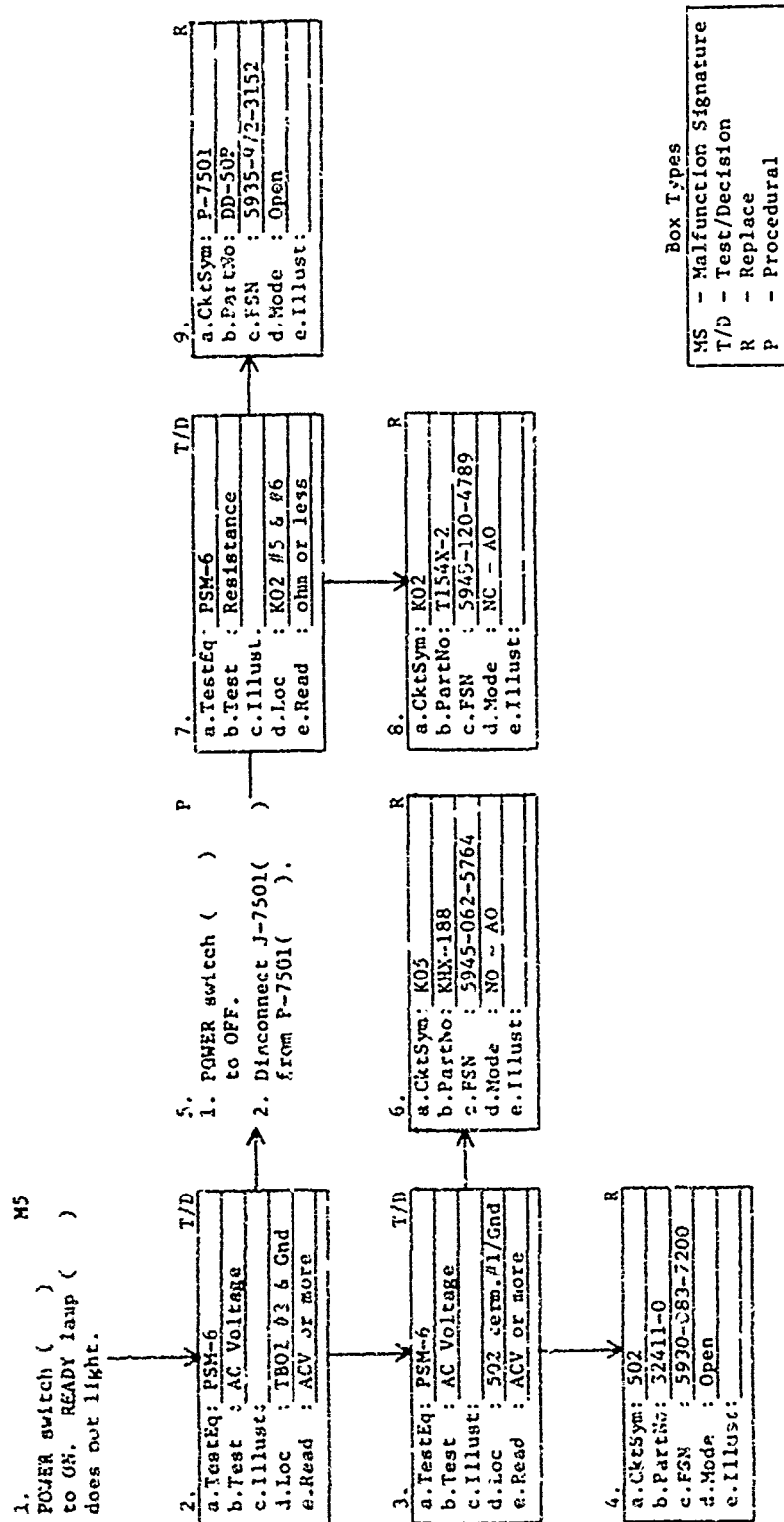


Figure 28. Sample Action Tree

(1) Circuit Symbol (for non-electrical parts, use Reference Designation)

(2) Part Number

(3) Federal Stock Number

(4) Malfunction Mode - For example, a switch might be "normally closed but always open".

(5) Illustration - This space is filled with an illustration reference number when one is assigned.

c. Test/Decision box, which shall contain the following information:

(1) Test Instrument (if any)

(2) Type of Reading (e.g., voltage, pressure, torque)

(3) Illustration - This space shall be filled with an illustration reference number when one is assigned.

(4) Location of Test Points - The unique equipment location at which (or between which) the test is made.

(5) Reading and Tolerance - (e.g., \_\_\_\_\_ VDC or more) The blank in this statement is filled in when the limit of variation of the subject component output has been determined.

d. Procedural boxes, which shall contain steps that are performed in a fixed sequence. These steps shall be derived from the corresponding step descriptions derived during task analysis (3.2). Any number of steps may be included in a Procedural box.

3.4.11.2 Requirement for Dichotomous Outcomes. All test/decision boxes in the action tree shall be written to permit only two outcomes. If one test or measurement can have more than two outcomes that have different diagnostic implications, then additional decision boxes shall be written.

3.4.11.3 Coverage Test. The contractor shall verify that all components and modes identified earlier as the contributors to the malfunction symptom for which the action tree was written appear in the repair or replace boxes of the action tree.

3.4.11.4 Criteria for Action Tree Development. The following criteria shall be applied, during the development of action trees, to the decision of what check comes next:

a. Modified Half-Split Troubleshooting Strategy. The sequence of checks (tests) in the modified half-split strategy maximized information gain per unit cost. Assuming a single malfunction, each check that is made indicates whether the malfunction is upstream or downstream of the check. The half-split strategy dictates that tests are chosen so that the probability that the malfunction is upstream of the check equals the probability that it is downstream. Consideration of the remaining criteria defines the modified half-split strategy.

b. Equipment Status Constraints. Certain checks are prerequisite to others because of equipment interrelationships.

c. Accessibility. Checks that are quick and easy should be called for early. Checks that involve extensive or difficult disassembly should be specified toward the end of the procedure.

d. Probability of Malfunction Introduction. Those checks which involve activities with high probability of accidental equipment damage should be deferred toward the end of the procedure.

e. Location. Other things equal, the sequence of checks should minimize the movement of the technician from one location to another. However, if more than one technician will be working simultaneously, and if these technicians can easily communicate, the location criterion may be ignored when checks are sequenced.

f. Availability of Special Tools and Test Equipment. Those checks that call for the use of tools and test equipment that are not commonly available should, other factors equal, be performed later in the procedure.

3.4.12 Checkout Procedure. After all action trees for a functional unit are completed, a checkout procedure shall be prepared which relates the malfunction symptoms to the action trees. The checkout procedures shall be primarily a linear procedure of steps and checks, with branching to isolation procedures (action trees). In rare instances, a checkout procedure may contain internal branching (to fully define a malfunction symptom) before an action tree is referenced in a Malfunction Symptom box.

3.4.12.1 Checkout Procedure Components. The checkout procedure shall be composed of Test/Decision boxes, Procedural boxes, Replace boxes, and Malfunction Symptom boxes, as defined in 3.4.11.1. However, the Malfunction Symptom boxes shall be terminal rather than initial boxes, and shall contain a space for an action tree page number which shall be filled in when known.

3.4.12.2 Criteria. The sequence of checks in a checkout procedure shall be determined by the same classes of criteria as in 3.4.11.4, to the extent that they are applicable.

3.4.13 Reading and Tolerance Data. Nominal values of indications (readings) and allowable variations from nominal values (tolerances) shall be provided for every step in a checkout procedure or action tree where that information is required to complete the step.

3.4.13.1 Obtaining Readings and Tolerances. Readings and tolerances shall be determined empirically to the extent that this approach is contractually required by the Procuring Agency. Empirical determination of this information shall be in accordance with the following procedure or its equivalent. Information obtained from this procedure shall be recorded on the "Reading and Tolerance Data Collection Form". A partially completed sample is shown in Figure 21.

- a. Beginning with the Malfunction Symptom box of an action tree, follow the instructions of the action tree to the first Test/Decision box. This box will have a missing value beside the word "Read".
- b. Follow the "down" path from the first Test/Decision box to its ultimate end in a Replace box. Note the component to be replaced and its failure mode.
- c. Install a device (or modify the equipment) in such a way as to simulate various degrees of component failure, so that the resulting degradation of function or signal will be similar to that produced by the specified mode of failure of the subject component.
- d. Set up test equipment specified in the first Test/Decision box to perform the indicated measurement.
- e. Vary the degree of simulated component failure until the malfunction symptom appears.
- f. Record the test equipment reading at which the function fails. (3.4.7)
- g. Readjust the degree of component failure until the subsystem just operates normally.
- h. Again record the test measurement value.
- i. Note any problems or difficulties encountered either with the check or the procedural steps leading to the check.
- j. Repeat steps b through i for all other Replace boxes linked to the first Test/Decision box. This is done to verify the logic of the action tree. Repeat steps a through i for each other Test/Decision box.

Sheet 1 of 17

**Hardware Item:** Analog Converter

Action Tree Box Number: ( AC 347 )

Data Collector

[illegible]

Figure 21. Sample Partially Completed Reading and Tolerance Data Collection Form

3.4.13.2 Upon conclusion of the above steps, the technician who gathered the reading and tolerance data shall describe to the preparer of the action tree the problems noted during the gathering of readings and tolerances. This information shall be used to improve the accuracy and completeness of the action tree. The reading and tolerance values which appear on the Data Collection Form shall be entered in the appropriate blanks of the action trees and checkout procedures.

3.4.14 Review and Approval. All Action Trees and Checkout Procedures for each subsystem shall be submitted for review and approval after the coverage test (3.4.11.3) and after all reading and tolerance information has been entered. Accompanying these products shall be a statement to the effect that the troubleshooting procedures represented by these products effectively isolate the cause of all possible malfunctions (within the system) to the replaceable or repairable hardware item causing each malfunction.

3.4.15 Conversion to JPA. The checkout procedures and the action trees prepared as specified in 3.4.11 and 3.4.12 shall be converted into Fully Proceduralized Troubleshooting Aids which meet the requirements specified in 3.3 and subparagraphs thereof, and the following additional requirements.

3.4.15.1 Cross Referencing Within Fully Proceduralized Troubleshooting Aids. Fully proceduralized troubleshooting aids shall be produced in scrambled book form. The troubleshooting aid shall instruct the technician to observe that certain equipment indications or conditions are present. Depending upon whether the specified indication is present or absent, the technician shall be instructed to branch to a new task, or he shall be free to continue by performing the next indicated task in the procedure. The following procedures will be used to refer the technician to the correct instructions as appropriate (see Figures 17 & 18 for examples):

- a. Reference to another task on the same page. An arrow shall be drawn from the task step containing the branching instruction to the appropriate task step.
- b. Reference to the Next Task, Which is the First Task on the Next Page. An arrow shall be drawn from the task step containing the branching instruction to the right edge of the paper.
- c. Reference to Another Task in the Same Section or in Another Volume. An arrow shall be drawn from the task step containing the branching instruction to a reference paragraph containing the reference. Whenever a replacement or repair operation is completed, the technician shall be directed to return to the first page of the same section.

3.4.16 Index Manual. There shall be a separate index manual covering all volumes of Fully Proceduralized Troubleshooting Aids that pertain to one system. The index shall be divided into six sections (as described below), providing volume and page references for all troubleshooting procedures.

3.4.16.1 Front Matter. Requirements are specified in 3.3.7.

3.4.16.2 Page Numbering. Pages of the index manual shall be numbered in consecutive order within sections. An individual page shall have the section number followed by a hyphen and the page number within that section. For example, the first page in the first section will be numbered 1-1; the third page in that section will be number 1-3; the first page in the fourth section will be numbered 4-1.

3.4.16.3 Listing by Subsystems. The first section in the index manual shall be a listing of troubleshooting procedures indexed by subsystems and functional units, and providing volume and page references to all troubleshooting procedures dealing with the listed hardware categories. (See Figure 22).

3.4.16.4 Listing by Indicators. The second section shall be a listing of troubleshooting procedures indexed by all indicators (other than lights and sight gauges) on all instruments or control panels used by crew members. Within these sections, all left-hand pages shall contain the listings of indicators and volume and page references, and all right-hand pages shall contain illustrations of all panels (with callouts to all indicators) mentioned on the facing page. Illustration callout numbers shall be inserted in the index listings at each mention of an indicator. All illustration requirements shall be identical to those for other troubleshooting aid manuals. (Figure 23).

3.4.16.5 Listing by Lights. The third section shall be a listing of troubleshooting procedures indexed by all warning and other indicator lights on all instrument, indicator, or control panels used by crew members. Within these sections, all left-hand pages shall contain the listings of lights and their volume and page references. All right-hand pages shall contain illustrations of the panels (with callouts to all lights) mentioned on the facing page. Illustration callout numbers shall be inserted in the index listings at each mention of a light. All illustration requirements shall be identical to those for other troubleshooting aid manuals.

3.4.16.6 Listing by Circuit Breakers. The fourth section shall be a listing of troubleshooting procedures indexed by all circuit breakers on all breaker panels used by crew members. Within these sections, all left-hand pages shall contain the listings of breakers and volume and page references, and all right-hand pages shall contain illustrations of all panels (with callouts to all breakers mentioned on the facing page. Illustration callout numbers shall be inserted in the index listings at each mention of an indicator. All illustration requirements shall be identical to those for other troubleshooting aid manuals.



T.O. JPA-1H-1(u)-2TS-1		
TROUBLESHOOTING AIDS		
LISTING		
ELECTRICAL		
	JPA 1H-1H-2TS-	Page
○	Battery System	4, 2-1
	Battery System (Alt Compartment)	20, 1-1
○	Battery System (Forward Compartment)	20, 2-1
○	External Power System	4, 1-1
	DC Generation and Bus System	4, 1-1
	AC Generation System	4, 4-1
PROPULSION		
○	Lubrication System	3, 1-1
	Fuel Supply and Fuel Control System	3, 1-1
○	Fuel Pressure Section	10, 3-1
	Fuel Boost Pump Section	16, 5-1
○	Governor (AUTO- EHEP) Switch Section	15, 2-1
1-1		

Figure 22. Sample Page from Listing by Subsystems Section

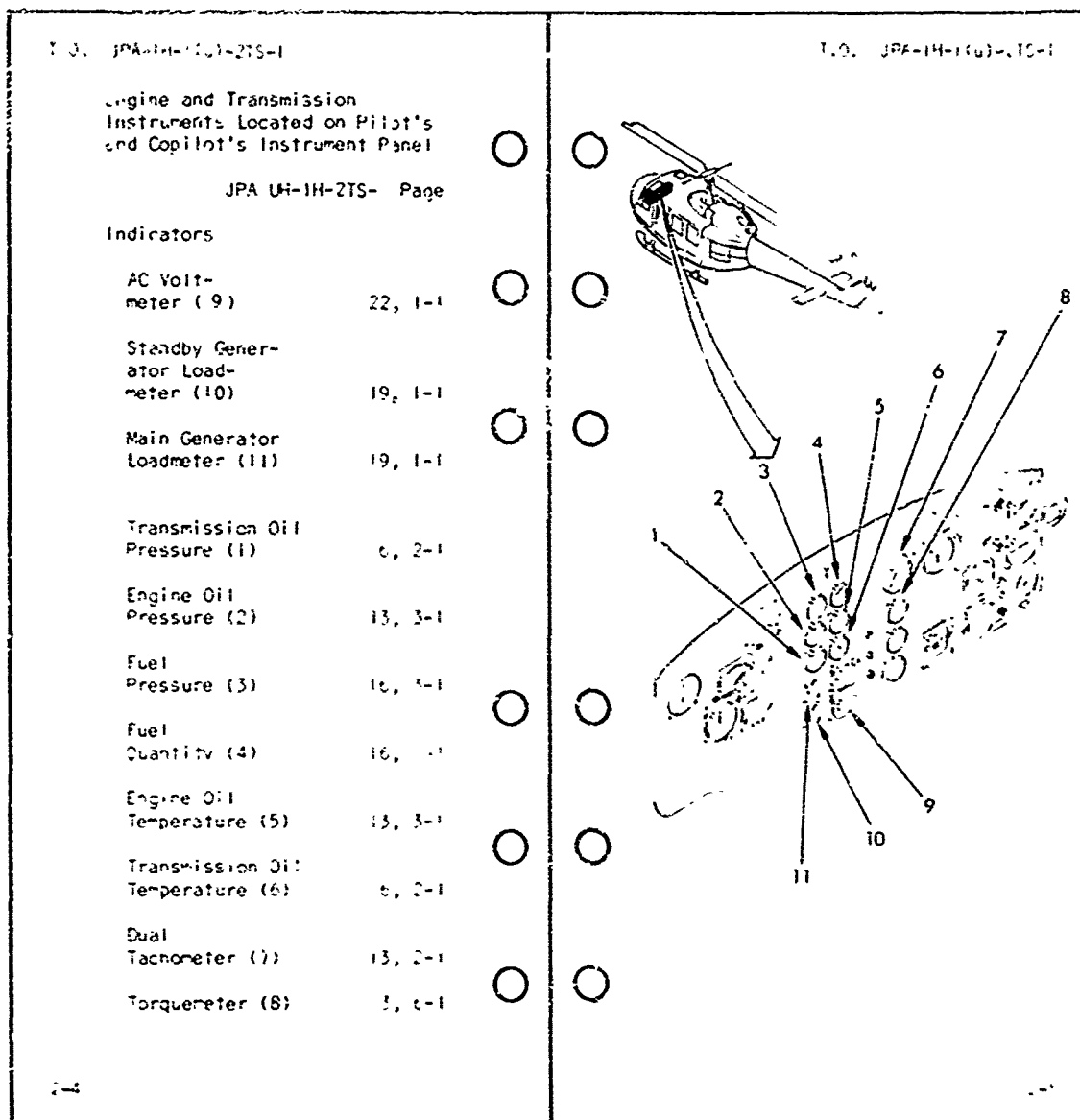


Figure 23. Sample Pages from Listing by Indicators Section

3.4.16.7 Listing by Sight Gauges. The fifth section shall contain a listing of troubleshooting procedures indexed by sight gauges used by crew members. Within this section, all left-hand pages shall contain the listings of sight gauges and their volume and page references. All right-hand pages shall contain illustrations of the assemblies containing sight gauges, with general locator pictures and callouts pointing to the gauges.

3.4.16.8 Listing by Malfunction. The sixth section shall be a listing of all malfunction symptoms which are identified during system check-outs and which initiate the development of action trees. The symptoms shall be arranged within the systems and subsystems to which they apply, and the symptoms shall be accompanied by references to the appropriate troubleshooting procedures.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 In-Process Reviews. All JPA manuals shall be subject to in-process review prior to publishing. Intermediate products shall be subject to review as stated in 3. REQUIREMENTS. Reviews may be conducted at the contractor's facility or his source facility at any time during the development of the JPA. However, reviews shall be held prior to preparation of final reproducible copy.

4.1.1 In-Process Reviews shall be executed by the Government (Government's participation at its option) and the contractor in a timely manner. The contractor shall be responsible for the establishment of the schedule that will permit the Government to review the contractor's mode of preparation, compliance with specifications, technical content, and problem areas.

4.1.2 In-Process Reviews will normally be initiated at the discretion of the cognizant service; however, reviews may be requested by the contractor when assistance or clarification is desired.

4.2 Pre-publication review, validation, and verification shall be conducted in accordance with TO 00-5-1.

4.3 Other quality assurance provisions shall be in accordance with MIL-M-38784 and MIL-P-38790.

#### 5. PREPARATION FOR DELIVERY

5.1 Packaging, packing, and marking for shipment shall be in accordance with MIL-M-38784 and MIL-P-38790.

#### 6. NOTES

6.1 Definitions. The following definitions shall apply:

6.1.1 Action Tree. An action tree is a pictorial representation of a branching troubleshooting procedure. It results from the application of a set of criteria (strategy) to the decisions concerning the equipment check to be next performed.

6.1.2 Activity. A single maintenance task or a group of tasks, all related to a higher order maintenance function; such as checking or adjusting a number of similar hardware items (e.g., flight instruments or door hinges).

6.1.3 Aircraft. Any weight carrying structure for navigation of the air, designed to be supported either by buoyancy of the structure or by the dynamic action of the air against its surfaces.

6.1.4 Assembly. A number of parts or sub-assemblies or any combination thereof joined together in order to perform a specific function.

6.1.5 End Item. A finished item complete within itself, whether a simple piece or made up of many pieces, and ready for its intended use.

6.1.6 Equipment. A unit or units and necessary assemblies, sub-assemblies and parts connected or associated together to perform an operational function.

6.1.7 Functional Segment. The smallest hardware division within a functional unit that is replaced at the organizational level of maintenance, assuming that the functional unit is divisible. An example of a functional segment for an avionics functional unit would be a Line Replaceable Unit (LRU), such as the Antenna, Receiver Transmitter, Control, Indicator, and Frequency Tracker which are LRUs of the APN-147 Doppler Radar.

6.1.8 Functional Unit. A set of equipment one class order lower than system which provides control or an input to a basic function. It is possible that for some basic system functions there will be no distinction between subsystems and functional units if the basic function is performed by only one functional unit. Examples of functional units for a navigation system are a Navigation Radar, and a Navigation Computer.

6.1.9 Group. A collection of units, assemblies, or sub-assemblies which is a subdivision of a system, but which is not capable of performing a complete operational function.

6.1.10 Item. A generic term used to identify the specific entity under consideration. As such, it may be a part, sub-assembly, group, equipment, etc. (MIL-STD-471).

6.1.11 Line Removable Item (LRI). An item which is removable at the organizational level of maintenance. This may range from the equipment down to the part level. May also be referred to as a Line Removable Unit (LRU).

6.1.12 Module. A combination of components contained in one package, or so arranged as to be mounted together, which provide a complete function or functions to the subsystem or system in which they operate.

6.1.13 Part. One piece, or two or more pieces joined together which are not normally subject to disassembly without destruction of designed use.

6.1.14 Referenced and Created Data Bases. Since much of the data required to prepare job performance aids for existing systems may be contained in existing documentation, such data is to be referenced rather than duplicated in a separate data base. This data is referred to as the Referenced Task Description Data Base. Other data, however, must be generated, modified, or updated to meet the requirements for job performance aids development. Such data must be collected and stored in a special data base for use by the job aid formatter. This is referred to as the Created Task Description Data Base.

6.1.15 Stage. A combination of two or more parts which form a portion of a sub-assembly and is usually not replaceable as a whole.

6.1.16 Sub-assembly. Two or more parts which form a portion of an assembly or a unit replaceable as a whole, but having a part or parts which are individually replaceable.

6.1.17 Subsystem. A combination of equipments, groups, etc., which performs an operational function within a system. Subsystems form the major subdivisions of systems. Examples of subsystems include navigation, communication, electrical, and propulsion.

6.1.18 Subtask. Any group of related behaviors which fulfills a limited purpose within a task. For example, "open access doors" or "set up test equipment" may be subtasks within an inspection or check-out task.

6.1.19 System. A combination of two or more subsystems generally physically separated when in operation, and such other assemblies, sub-assemblies and parts necessary to perform an operational function or functions. An aircraft is an example of a system.

6.1.20 Task. A group of related behaviors required of a maintenance technician within a given work cycle or routine (e.g., from work order through cleanup) which is directed toward a specific work objective; and consists of the composite of the information, decisions, and responses required to accomplish a unit of work. (DH 1-3).

6.1.21 Task Description Data Base. The task description data base consists of the data which are required to describe how each task identified in the Task Inventory is to be performed, who performs the task, when a task is to be performed, the conditions under which the task is performed, and what supporting tools, test equipment, and supplies are required to perform the task. The data base provides content for the job performance aid manuals, and a structure that facilitates formatting of the manuals.

6.1.22 Task Description Index and Management Matrix. To manage both the Created and the Referenced Task Description Data Bases, it is necessary to prepare a data indexing, storage, and management form. The data indexing and management form to be prepared consists of a matrix. The row headings in this matrix are the task inventory statements and codes. The column headings are the categories of information required for each task. The cell entries provide the actual data or a reference to where the data is stored in the Referenced or Created data bases.

6.1.23 Task Identification Matrix (TIM). The TIM consists of a two-dimensional array of column and row headings and cell entries. The row headings consist of the names for all subsystems, equipments, assemblies, etc., to the lowest level of system subdivision with which organizational maintenance personnel will interact. The column headings consist of the names of maintenance functions performed at the organizational level. The cell entries in the matrix identify if a given maintenance function is performed on a given item of hardware at a specified level within the hardware item (row heading) list. Each intersection of a hardware item and a maintenance function identifies a possible task.

6.1.24 Task Inventory. The Task Inventory is a list of the names and identifying codes of all tasks that must be performed by maintenance technicians at the organizational level for all of the subsystems under consideration. The task names are made up of the combination of the column heading and row heading that defines the cell, i.e., "checkout transmitter" in the Task Identification Matrix.

6.1.25 Task Step. A basic unit of behavior (made up of the smallest logically definable set of information, decisions, and responses) which the maintenance technician is required to perform in completing a task or subtask; e.g., a single action identified by a specific signal on a specified display or other source of information, a specific control actuation or other identifiable response, and a feedback signal indicating the adequacy of the response. (DII 1-3).

6.1.26 Unit. An assembly or any combination of parts, sub-assemblies and assemblies mounted together, normally capable of independent operation in a variety of situations.

6.2 Verb List. In the following list, each verb is defined in terms of one or more meanings associated with aircraft maintenance. A sample sentence has been provided for each usage. A number entry in the preference rank column indicates the standing of that verb compared to others with the same or similar meaning (highest rank is 1). Synonyms with which the verb was ranked are listed, in terms of their own ranking. If a synonym holds first rank, it is underlined. Where necessary, special notes are also included. Lower ranking verbs can be used when the first-ranked verb is particularly awkward or misleading in a given statement.

VERBS	DEFINITIONS	EXAMPLES	PREF. SYNONYMS BY ORDER		NOTES
			RANK	OF PREFERENCE	
Accomplish	To do, carry out or bring about; to reach an objective.	Accomplish a periodic inspection on the landing gear.	2	1. Perform 3. Effect	
Actuate	To put into mechanical motion or action; to move to action.	Actuate the handpump until the pressure gage indicates 3000 psi.	-		
Adapt	To make fit a new situation or use, often by modifying.	Use the bushing to adapt the fuse to the projectile.	-		
Add	To add more in.	Add water to the battery.	-		
Adjust	1. To bring to a specified position or state. 2. To bring to a more satisfactory state; to manipulate controls, levers, linkages, etc., to return equipment from an out-of-tolerance condition to an in-tolerance condition.	1. Adjust the micrometer to the given measurements. 2. Adjust cable tension using the turnbuckles.	-		
Advise	To give information or notice to.	Advise man B that the brakes have been set.	4	1. Report to 2. Inform 3. Notify 5. Communicate to	
Advance	To move forward; to move ahead.	Advance the throttle.	-		
Agitate	To move with a jerky, quick or violent action.	Agitate the container so that the paint will be well mixed.	2	1. Shake	
Aid	To give help or support to; to assist.	Aid man B to lift the load.	3	1. Assist 2. Help	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Alert	To warn; to call to a state of readiness or watchfulness; to notify (a Person) of an impending action.	Alert personnel that area will be cleared.	-		
Align	To bring into line, to line up; to bring into precise adjustment, correct relative position or coincidence.	Align slot in turnbuckle barrel with slot in cable terminal.	-		
Allocate	To apportion for a specific purpose or to particular persons or things.	Allocate the various maintenance tasks to technicians.	3	1. Assign 2. Distribute	
Allow	1. To permit, to give opportunity to. 2. To allot or provide for.	1. Allow the sediment to settle out. 2. Allow a 2-inch slack in the rope.	1 1	2. Let 2. leave	
Alternate	To perform or cause to occur by turns or in succession.	Alternate between pilot's and copilot's instrument test.	-		
Analyze	To examine and interpret test or inspection results to determine system or equipment condition or capabilities.	Analyze engine inspection findings to determine need for repairs.	-		
Apply	1. To lay or spread on. 2. To energize	1. Apply sealant to gap between the windshield and the aircraft structure. 2. Apply power or load.	1 -	2. Put	Use "lubricate" rather than "apply lubricant."



VERBS	DEFINITIONS	EXAMPLES		PREF. RANK		SYNONYMS BY ORDER OF PREFERENCE		NOTES
Arrange	To group according to quality, value or other characteristics, from smallest to largest. to put in proper order.		Arrange components by size	1		2. Order		
Ascertain	To find out with certainty that a proper condition exists.		Ascertain that the light is off.	5		1. Be sure 2. Verify 3. Check 4. Determine		
Assemble	To fit and secure together the several parts of; to make or form by combining parts.		Assemble a jet engine in accordance with specified procedures.	1		2. Construct		
Assess	To determine the importance, size or value of; to evaluate.		Assess the success of the maintenance action.	2		1. Evaluate		
Assign	To apportion to for a specific purpose or to particular persons or things; to appoint to a duty.		Assign the various maintenance tasks to technicians.	1		2. Distribute 3. Allocate		
Assist	To give support or help; to aid.		Assist man B to lift the antenna.	1		2. Help 3. Aid		
Assure	To make someone sure or certain, to inform positively.		Assure other technicians that all warning lights are off.	-				
Attach	To join or fasten to.		Attach electrical leads to the multimeter.	2		1. Connect 3. Mate 4. Join		Use "tag" in preference to "attach" & tag.
Back off	To cause to go in reverse or backward.		Back off nut to the nearest castellation.	-				
Balance	To equalize in weight, height, number or proportion.		Balance aircraft so that it is stable.	-				

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Be sure	To confirm that a proper condition exists, to find out with certainty.	Be sure that the light is off.	1	2. Verify 3. Check 4. Determine 5. Ascertain	
Be careful	To exercise caution, to take care.	Be careful not to inhale the fumes of the solvent.	-		
Bend	To turn or force from straight or even to curved or angular, or to force, back to an original straight or even position.	Bend wire until it lies flat against the turnbuckle wall.	-		
Bleed	To extract or let out some or all of a contained substance from.	Bleed off tank air pressure.	-		
Blow	To send forth air, particularly from the lungs through the mouth.	Check for obstructions by disconnecting the hose at the air inlet and blowing through it.	-		
Break	1. To separate into parts with suddenness or violence. 2. To pull away.	1. Never break safety wire to release air pressure. 2. Break the head of the tire.	-		
Buck	To reseal or tighten rivets from the shank side.	Buck rivets to stop the leak.	-		
Calculate	To determine by arithmetic processes.	Calculate the voltage in a circuit with 10 amp of current and 5 ohms of resistance.	1	2. Figure 3. Compute	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Calibrate	To determine accuracy, deviation or variation by special measurement or by comparison with a standard.	Calibrate torque handle; at least once each month so that the accuracy can be depended upon.	-		
Cap	To provide with a covering; to install or provide with a device for closing off the end of a tube which has a male fitting.	Cap all lines which have exposed male fittings.	1	2. Install caps	
Care for	To take responsibility for the proper handling and upkeep of.	A mechanic cares for his tools.	-		
Catch	To prevent from falling to the ground, to capture.	Catch any fluid drippings in a drip pan.	-		
Categorize	To put into categories or general classes.	Categorize components by their function.	2	1. <u>Classify</u>	For determining the classification of a supply item, use "identify."
Center	1. To adjust so that axes coincide. 2. To place in the middle of.	1. Center the nose wheel of the aircraft. 2. Center the pointer on the dial.	-		
Change	To replace with another comparable item; to substitute serviceable equipment for malfunctioning, wornout or damaged equipment.	Change the switch contact points.	2	1. <u>Replace</u>	
Channel	To form, cut, or wear a groove in.	Channel the rods so that they can be inserted easily.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Charge	To restore the active materials in a storage battery by the passage of a direct current through in the opposite direction to that of the discharge.	Charge the battery for a short time before making a specific gravity check.	1	2. Cycle	
Check	1. To confirm or establish that a proper condition exists; to ascertain that a given operation produces a specified result; to examine for satisfactory accuracy, safety or performance; to confirm or determine measurements by use of visual or mechanical means. 2. To perform a critical visual observation or check for specific conditions; to test the condition of.	1. Check that the light is off. 2. Check the components for wear, deterioration or defects.	3	1. <u>Be sure</u> 2. <u>Verify</u> 4. <u>Determine</u> 5. <u>Ascertain</u>  1. <u>Inspect</u> 2. <u>Examine</u>	
Checkout	To perform specified operations to verify operational readiness of a subcomponent, component, subsystem, or system.	Checkout the landing gear.	1	2. Test	
Chock	To place a blocking device, designated by the Air Force as a chock, adjacent to, in front of, and behind to keep from moving.	Chock main and nose landing gear wheels.	-		

VERBS	DEFINITIONS	EXAMPLE'S	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Choke	To enrich the fuel mixture of a motor by partially shutting off the air intake of the carburetor.	Choke engine as required to start.	-		
Clamp	To fasten or press two or more parts together so as to hold them firmly.	Clamp the tensiometer to the cable by releasing the handle slowly.	-		
Classify	To put into categories or general classes.	Classify components by their function.	1	2. Categorize	For determining the classification of a supply item, use "Identify".
Clean	To wash, scrub or apply solvents to; remove dirt, corrosion or grease.	Clean petroleum products from oxygen equipment.	-		
Clear	1. To move people and/or objects away from. 2. To open the throttle of an idling engine to free it from carbon.	1. Clear the area. 2. Clear the engine.	-		
Close	1. To block against entry or passage; to turn, push or pull in the direction in which flow is impeded. 2. To set a circuit breaker into the position allowing current to flow through.	1. Close the valve. 2. Close the circuit breaker.	-		
Coat	To cover or spread with a finishing, protecting layer.	Coat battery cables with grease.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Code	To put into the form or symbols of a system used to represent words; to mark with identifying symbols.	Color code equipment parts.	-		
Collect	To bring together into one body or place; to accumulate.	Collect the required hand tools.	-		
Communicate	1. To exchange information. 2. To make known.	1. Communicate with man B during the entire procedure. 2. Communicate to man B that the brakes have been set.	- 3	1. <u>Report to</u> 2. <u>Inform</u> 3. <u>Notify</u> 4. <u>Advise</u>	
Compare	To examine the character or qualities of two or more items to discover resemblances or differences.	Compare the readings from protractor and template.	-		
Compile	To compose or put together out of materials from several sources.	Compile the records of all maintenance on the specified aircraft.	-		
Comply	To conform with directions or rules; to accept as authority, to obey.	Comply with directions.	2	1. <u>Follow</u>	
Compress	To squeeze together; to condense.	Compress the forward and aft sections of the hydraulic pitch lever.	-		
Compute	To determine by arithmetic processes.	Compute the voltage in a circuit with 10 amps of current and 5 ohms of resistance.	3	1. <u>Calculate</u> 2. <u>Figure</u>	
Condition	To put into a proper state for work or use.	Condition components before installing them.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Conduct	To lead, manage or direct.	Conduct the class in proper servicing procedures.	-		
Confer	To consult; to exchange views.	Confer with maintenance supervisor if necessary.	-		
Connect	1. To bring or fit together so as to form a unit, to couple keyed or mate equipment items. 2. To attach or mate (an electrical device) to a service outlet.	1. Connect the antenna cable to the radio transmitter. 2. Connect the soldering iron to the service power outlet.	1 2	2. Attach 3. Mate 4. Join 1. <u>Plug in</u>	
Consolidate	To join together into one whole, to form into a compact mass.	Consolidate contents of both containers.	-		
Construct	To make or form by combining parts; to fit and secure together the several parts of.	Construct a jet engine in accordance with specified procedures.	2	1 <u>Assemble</u>	
Control	To exercise restraining or directing influence over, to fix or adjust the time, amount or rate of.	Control electrical current generation and distribution.	2	1. <u>Regulate</u>	
Coordinate	To bring into a common action, movement or condition.	Coordinate the activities of man B and man C.	-		
Copy	To make an imitation, transcript or reproduction of.	Copy the tail number on the record form.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Correct	To make or set right, to alter or adjust so as to bring to some standard or required condition.	Correct any error before proceeding with activity.	-		
Cover	To protect or shelter by placing something over or around.	Cover tires whenever maintenance is done on the aircraft.	-		
Crack	To open slightly (the throttle) of an aircraft engine preparatory to starting the engine.	Crack and lock the throttle to 1/8 open.	-		
Cut	To divide into parts using a sharp instrument such as a scissors or knife.	If the prongs of the cotter pin are too long, they should be cut to proper length.	-		
Cycle	To charge (a battery) for a short time.	Cycle the battery before making the specific gravity check.	2	1. Charge for a short time.	
Deflate	To release air or gas from.	Deflate the shock strut to check fluid level.	-		
Deflect	To move aircraft control surfaces (elevators, ailerons, etc.) to a position different from the major axes of the aircraft.	Deflect the surface upward to the mechanical stops.	-		
Deplete	To lessen markedly in quantity, content or power.	Deplete system pressure.	-		
Depress	To press or push down.	Depress both brake pedals.	-		



VERBS	DEFINITIONS	EXAMPLES	SYNONYMS BY ORDER		NOTES
			PREF. RANK	OF PREFERENCE	
Depressurize	To release gas or fluid pressure from.	Depressurize the hydraulic system.	-		
Destroy	To ruin, demolish or put out of existence; to make unfit for further use.	Destroy used hydraulic fluid containers.	-		
Detect	To discover or determine the existence, presence or fact of.	Watch very carefully so as to detect any needle movement.	-		
Determine	1. To obtain definite and first-hand knowledge of, to confirm or establish that a proper condition exists. 2. To investigate and decide to discover by study or experiment.	1. Determine that the light is off. 2. Determine the amount of tension on a cable by following specified procedures.	4 1	1. Be sure 2. Verify 3. Check 5. Ascertain 2. Find	
Develop	To set forth or make clear by degrees or in detail.	Develop procedures fully.	-		
Devise	To form by new combinations or applications of ideas or principles; to invent.	Devise new methods of troubleshooting the system.	-		
Diagnose	To recognize and identify the cause or nature of a condition, situation or problem by examination or analysis.	Diagnose the malfunction.	-		
Disassemble	To take to pieces; to take apart to the level of the next smaller unit or down to all removable parts.	Disassemble the No. 1 engine.	1	2. Dismantle	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Dismantle	To take to pieces; to take apart to the level of the next smaller unit or down to all removable parts.	Dismantle the No. 1 engine.	2	1. <u>Disassemble</u>	
Disconnect	1. To sever the connection between; to separate keyed or matched equipment parts. 2. To detach or separate (an electrical device) from a service outlet.	1. Disconnect the bleedair hose from the leading edge anti-icing system. 2. Disconnect the soldering iron from the service power outlet.	- 2	 1. <u>Unplug</u>	
Disengage	To release or detach interlocking parts, to unfasten; to set free from an inactive or fixed position.	Disengage the parking brake.	2	1. <u>Release</u> 2. <u>Unhook</u>	For circuit breaker, use "open".
Dispatch	To send off or away with promptness or speed.	Dispatch report to supervizing technician.	-		
Dispose of	To get rid of.	Dispose of unused hydraulic fluid left in the can.	-		
Distribute	1. To apportion for a specific purpose or to particular persons or things. 2. To divide among several or many; to divide or separate, especially into kinds.	1. Distribute the various maintenance tasks to technicians. 2. Distribute paint for various sections of the aircraft.	2 -	1. <u>Assign</u> 3. <u>Allocate</u>	
Drain	To draw off (liquid) gradually or completely.	Drain servicing hose after removing it from the filter valve.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Draw in	To pull (liquid) up into a container through suction.	Fill hydrometer by drawing in electrolyte.	-		
Dry	To cause to be free from water or liquid.	Dry bearings with low-pressure air.	-		
Effect	To do, carry out or bring about; to reach an objective.	Effect a periodic inspection on the landing gear.	3	1. Perform 2. Accomplish	
Eliminate	To expel; to ignore or set aside as unimportant.	Eliminate all unnecessary movement.	-		
Employ	To put into action or service, to carry out a purpose or action by means of; to avail oneself of.	Employ only antimagnetic fasteners.	3	1. Use 2. Utilize	
Enforce	To compel or constrain.	Enforce safety regulations.	-		
Engage	To cause to interlock or mesh.	Engage threads of turnbuckle with threads of cable terminal.	-		For circuit breakers, use "close".
Enter	1. To go or come in. 2. To put on record.	1. Enter the aircraft through the troop doors. 2. Enter the data on the form.	-		
Erect	To put up by the fitting together.	Erect a special maintenance stand.	-		
Establish	To set on a firm basis.	Establish safety rules.	-		
Estimate	To judge or determine roughly the size, extent or nature of.	Estimate amount of cleaning solvent which will be necessary.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Evaluate	To determine the importance, size or nature of; to appraise; engine to give a value or appraisal to on the basis of collected data.	Evaluate an operating	1	2. Assess	
Examine	To perform a critical visual observation or check for specific conditions; to test the condition of.	Examine the component for wear, deterioration or defects.	2	1. <u>Inspect</u> 3. Check	
Expedite	To accelerate the process or progress of.	Expedite the activity by assigning two men.	-		
Extend	To cause to be drawn out to fullest length.	Extend the main landing gear.	-		
Extract	To draw forth; to pull out forcibly.	Extract the cotter pin.	-		
Fabricate	To construct from standardized parts.	Fabricate rig pins from 0.25 inch rod.	-		
Figure	To determine by arithmetic processes.	Figure the voltage in a circuit with 10 amps of current and 5 ohms of resistance.	-	1. <u>Calculate</u> 3. Compute	
File	To rub smooth or cut away with a file (i.e., a tool with cutting ridges for forming or smoothing surfaces).	File one end of the rod to a point.	-		
Fill	To put into as much as can be held or conveniently contained or to a specified level.	Fill oil and de-icing tanks.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Find	1. To discover or determine by search; to indicate the place, site or limits of.	1. Find the No. 9 fitting.	2	1. <u>Locate</u>	
	2. To discover by study or experiment; to investigate and decide.	2. Find the amount of tension on a cable by following specified procedures.	2	1. <u>Determine</u>	
Flush	To pour liquid over or through; to wash out with a rush of liquid.	Drain and flush the hydraulic system if it is serviced with a wrong fluid.	-		
Follow	To accept as authority; to obey; to conform with directions or rules.	Follow directions.	1	2. Comply with	
Form	To give a particular shape to; to shape or mold into a certain state; to make up.	Form the compound so that it will fill the hole completely.	-		
Furnish	To supply what is needed, to equip.	To furnish a flashlight for man B.	2	1. <u>Provide</u>	
Go to	To proceed to; to transport oneself to a given destination.	Go to the control pedestal and position switches appropriately.	-		
Ground	To connect a current, wire or a piece of electrical equipment to a land or other specified surface.	Ground the servicing cart.	-		
Guard	To protect from danger, to defend.	Guard the area while maintenance is taking place.	-		
Guide	To manage or direct the movement of.	Guide the maintenance stand safely to its new position.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. SYNONYMS BY ORDER		NOTES
			RANK	OF PREFERENCE	
Hand	To give, pass or transmit with the hands.	Hand the refueling hose to the technician stationed on the wing.	-		
Handle	To manipulate (load, turn, raise, etc.) objects and equipment manually or with specially designated equipment, such as hoists.	Handle larger cylinders carefully.	-		
Hang	To fasten to some elevated point without support from below, to suspend.	Do not hang tools on projecting parts of the aircraft.	-		
Help	To give support, aid or assistance to.	Help man B lift the load.	2	1. Assist 3. Aid	
Hold	To have or keep in the grasp.	Hold the power switch in position until the voltmeter stabilizes.	-		
Identify	1. To establish the identity of. 2. To determine the classification of a supply item.	1. Identify components by name and function. 2. Identify the component to be ordered from supply.	-		
Idle	To run an aircraft engine under reduced power without sufficient power being developed for movement of the aircraft.	Idle engine for five minutes at 800 rpm.	-		
Immerse	To plunge into something that surrounds or covers, especially to plunge or dip into a fluid.	Immerse component in solvent.	-		

VERBS	DEFINITIONS	EXAMPLES	PRES. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Improve	To make greater in amount or degree; to make better.	Improve procedures whenever feasible.	-		
Indicate	To point out.	Indicate which dial should be monitored.	-		
Inflate	To fill with a given amount of gas or air.	Inflate tire to desired pressure.	-		
Inform	To make known to; to give notice or report the occurrence of.	Inform man B that the brakes have been set.	2	1. Report to 3. Notify 4. Advise 5. Communicate to	
Initiate	To perform actions necessary to set into operation, to set going, to begin.	Initiate operation of the powered AGE.	2	1. Start 3. Originate	
Inject	To throw, drive or force in.	Inject lubricant into proper joint.	-		
Insert	To put or thrust in, into or through.	Insert a wire through the hole in the turnbuckle.	1	2. Put	
Inspect	To perform a critical visual observation or check for specific conditions; to test the condition of.	Inspect the components for wear, deterioration or defects.	1	2. Examine 3. Check	
Install	1. To perform operations necessary to properly fit an equipment unit into the next larger assembly or system.	1. Install fuel manifold.	-		a. For wiring a circuit, use either "install wiring" or "wire".

VERBS	DEFINITIONS	EXAMPLES	PREF. SYNONYMS BY ORDER RANK OF PREFERENCE		NOTES
Install: (Cont.)	2. To place and attach.	2. Install nuts on bolts.			b. For safety wiring use either "safety wire" or "install safety wire".
					c. For screws, use "install screws" rather than "screw".
					d. Use "cap" "plug" rather than "install caps (plugs)".
Insure	To make certain, to ensure.	Insure that the area is clear of unnecessary personnel and equipment.	-		
Intercept	To stop or interrupt the progress or course of.	Intercept messages between flight station and tail section technicians.	-		
Interpret	To explain the meaning of.	Interpret instructions for inexperienced technicians.	-		
Investigate	To observe or study by close examination and systematic inquiry.	Investigate the cause of the breakdown.	-		
Isolate	To use test equipment to identify or select a source of trouble.	Isolate the source of the malfunction using pressure gages.	-		
Jack	To use one or more jacks (i.e., mechanisms for exerting pressure to lift all or part of an aircraft).	Jack and level the aircraft in accordance with specified procedures.	-		



VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDLR OF PREFERENCE	NOTES
Join	To bring or fit together so as to form a unit; to couple keyed or matched equipment items.	Join the transmitter to the receiver with the power cable.	4	1. <u>Connect</u> 2. <u>Attach</u> 3. <u>Mate</u>	
Keep	To remain, to continue in a place.	Keep away from the danger area.	2	1. <u>Stay</u>	
Kick	To strike against with a foot.	Kick the wheel lightly if the strut binds.	-		
Latch	To catch with a device which holds a door when closed, even if not bolted.	Close and latch the aft petal doors.	-		
Leave	1. To go away from, depart. 2. To allot or provide for.	1. Do not leave the area until this activity is complete. 2. Leave a two-inch slack in the rope.	- 2	 1. <u>Allow</u>	
Let	To permit; to give opportunity to.	Let the engine stabilize.	2	1. <u>Allow</u>	
Level	To cause an aircraft to become even or parallel with the plane of the horizon.	Jack and level the aircraft in accordance with specified procedure.	-		
Lift	To move or cause to be moved from a lower to a higher position; to elevate.	Lift the spoiler control lever to the ARMED position.	2	1. <u>Raise</u>	
Light	To cause to illuminate.	Light the field indicator light.	-		
Listen	To pay attention to sound.	Listen to the engine while it is operating.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Load	To place in or on a means of conveyance; to place cargo or aircraft components on an airplane or other vehicle.	Load and secure aircraft components on specified truck.	-		
Locate	1. To find, determine or indicate the place, site or limits of. 2. To set or establish in a particular spot, to station.	1. Locate the No. 9 fitting. 2. Locate the test equipment so that it can be seen by both technicians.	1 3-4	2. Find 1. Position 2. Place 3-4. Set 5. Put	
Lock	To hold fast or inactive, to fix.	Lock the throttle after it has been properly set.	-		
Look for	To visually search for.	Look for cracks, corrosion and damage during inspection of wheels and tires.	-		
Loop	To make into the form or shape of a loop (i.e., a fold or doubling of line leaving an aperture between the parts through which another line can be passed).	Loop the wire.	-		
Loosen	To release from restraint, to cause to become less tight fitting.	Loosen the lock nut on the relief valve.	-		
Lower	To cause to move down; to depress as to direction.	Lower the exhaust stack into the stowed position.	-		
Lubricate	To put lubricant on specified locations.	Lubricate the wheel bearings.	1	2. Apply lubricant	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Maintain	1. To hold or keep in any particular state or condition, especially in a state of efficiency or validity. 2. To sustain or keep up.	1. An aircraft mechanic maintains aircraft. 2. Maintain standard forms on power plant operations.	-		
Make	To carry out or cause to occur.	Make corrections where necessary.	-		
Mark	To label, to provide with an identifying or indicating symbol.	Mark each component before removing it.	-		If marking is to be done on a tag, use "tag".
Mate	To join or fit together, to couple.	Mate the proper transmitter and receiver.	3	1. Connect 2. Attach 4. Join	
Measure	To determine the dimensions, capacity or amount by use of standard instruments or utensils.	Measure voltage drop across each unit of resistance.	-		
Mix	To combine or blend into one mass.	Never mix oxygen with other gases.	-		
Modify	To alter or change somewhat the form or qualities of.	A jet engine mechanic modifies turbofan engines.	-		
Monitor	1. To visually take note of, to pay attention to in order to check on action or change.	1. Monitor the indicator for changes in airspeed.	3	1. Observe 2. Watch	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Monitor (Cont.)	2. To continually or periodically attend to displays to determine equipment condition or operating status.	2. Monitor all engine instruments while starting the engines.	-		
Moor	To secure an aircraft to the ground by tying it down by ropes or cables.	Moor the aircraft when it is to be parked for an extended period of time.	-		
Mount	To attach to a support.	Mount the split-type wheel.	-		
Move	To change the location or position of.	Move and position a B-4 maintenance stand.	-		
Neutralize	To destroy the effectiveness of, to nullify, to make chemically neutral or electrically inert.	Neutralize the solution before applying it to aircraft surface.	-		
Notify	To make known to; to give notice or report the occurrence of.	Notify man B that the brakes have been set.	3	1. Report to 2. Inform 4. Advise 5. Communicate to	
Observe	1. To conform one's actions or practice to. 2. To visually take note of, to pay attention to.	1. Observe precautions. 2. Observe the indicator for changes in airspeed.	- 1		
Obtain	1. To get or find out by observation or special procedures. 2. To gain or attain.	1. Obtain a reading on the outside circle of the tensiometer. 2. Obtain the necessary supplies before starting on maintenance.	2 -	1. Take	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Open	1. To move from closed position; to make available for passage by turning in an appropriate direction. 2. To make available for entry or passage by turning back, removing or clearing away. 3. To disengage or pull.	1. Open the valve. 2. Open the troop door. 3. Open the appropriate circuit breakers.	-		
Operate	To control equipment in order to accomplish a specific purpose.	Operate crew stands and auxiliary power equipment.	-		
Order	1. To requisition or request from supply. 2. To group according to quality, value, or other characteristics.	1. Order three cans of appropriate solvent. 2. Order components by size from smallest to largest.	-	1. <u>Arrange</u>	
Organize	To arrange elements into a whole of interdependent parts; to form into a coherent unity; to integrate.	Organize the activities of the assisting technicians.	-		
Orient	1. To acquaint with the existing situation or environment. 2. To set or arrange in any determinate position.	1. Orient new technicians to location of shops and supplies. 2. Orient the aircraft away from wind direction.	-		
Originate	To give rise to, to set going, to begin.	Originate a new procedure.	3	1. <u>Start</u> 2. <u>Initiate</u>	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Overhaul	The act of disassembling equipment units down to all removable parts; cleaning; critically inspecting, re-pairing, restoring and re-placing where necessary; assembling, adjusting, aligning, recalibrating and verifying operational readiness by test or checkout; and packaging for transportation storage.	Overhaul the No. 2 engine.	-		
Pack	To fill completely with grease.	Pack the bearings.	-		
Paint	To apply color or pigment (suspended in suitable liquid) to the surface of.	Paint all exposed surfaces.	-		
Park	To bring (an aircraft) to a stop and leave it standing for a time, usually without pilot, in a specified area.	Park the aircraft between the yellow lines.	-		
Patch	To mend, cover, or fill up a hole or weak spot.	Patch the tubes where necessary.	-		
Perform	To do, carry out or bring about; to reach an objective.	Perform a periodic inspection on the landing gear.	1	2. Accomplish 3. Effect	
Place	To put or set in a desired location or position.	Place the test equipment so that it can be seen by both technicians.	2	1. <u>Position</u> 3-4. <u>Set</u> 3-4. Locate 5. Put	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Plan	To devise or project the achievement of.	Plan the day's schedule for the technicians.	-		
Plug	To provide with a device for closing off the end of a tube which has a female fitting.	Plug all lines which have exposed female fittings.	1	2. Insert plugs 3. Install plugs	
Plug in	To attach or mate (an electrical device) to a service outlet.	Plug in the soldering iron at the service power outlet.	1	2. Connect	
Position	To put or set in given place, to locate.	Position the test equipment so that it can be seen by both technicians.	1	2. Place 3-4. Set 3-4. Locate 5. Put	
Post	To station at a given place.	Post one man in front of the aircraft.	-		
Prepare	To make ready; to arrange things in readiness. To prepare or make ready for a maintenance activity.	Prepare the surface for paint. Prepare the "run" shaft kit for removal of the MLG shock strut.	- 1	 2. Set up 3. Ready	
Prescribe	To lay down as a guide, direction or rule of action; to specify with authority.	Prescribe repair activities to correct the malfunctions.	-		
Pre-set	To put in a desired position, adjustment or condition beforehand.	Pre-set tension indicator dial to size of cable being checked.	-		
Press	To act upon through thrusting force exerted in contact.	Press the blower start button.	1	2. Push	For circuit breakers, use "close".

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Pressurize	To apply pressure within by filling with gas or liquid.	Pressurize the booster hydraulic system.	-		
Prevent	To keep from happening or existing.	Prevent oil from spilling over on components.	-		
Probe	To investigate thoroughly with a long, pointed device or by direct feeling.	Probe the tube with fingers.	-		
Process	To submit to a series of actions or operations leading to a particular end.	Process the forms so they will be compatible with new recording methods.	-		
Program	To work out a plan or procedure or a sequence of operations to be performed.	Program the maintenance activity in logical sequence.	-		
Provide	To supply what is needed, to equip.	Provide a flashlight for man B.	1	1. Furnish	
Pull	To exert force upon an object so as to cause motion toward the force.	Pull out knob No. 6 on the oxygen servicing cart.	-		For circuit breakers, use "open".
Pump	1. Raise or lower by operating a device which raises, transfers or compresses fluids by suction, pressure or both. 2. To move up and down or in and out as if with a pump handle.	1. Pump up the pump several inches. 2. Pump engine primer knob.	-		
Puncture	To pierce with pointed instrument or object.	Be careful not to puncture tube while probing the inside of it.	-		



VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS & ORDER PREFERENCE; CE	NOTES
Purge	1. To free of sediment or trapped air by flushing or bleeding. 2. To remove fuel or fuel vapors from engine by motoring engine with fuel switch off.	1. Purge fuel tanks. 2. Purge engines.	-		
Push	1. To press against with force so as to cause motion away from the force. 2. To move away or ahead by steady pressure.	1. Push the blower start button. 2. Push the servicing cart toward the aircraft.	2	1. <u>Press</u>	For circuit breakers, use "close".
Put	1. To place in or through. 2. To place or set in a desired position or location. 3. To deposit or leave.	1. Put a wire through the hole in the turnbuckle. 2. Put the test equipment where it can be seen by both technicians. 3. Put tools out on the bench.	2 5 -	1. <u>Insert</u> 1. <u>Position</u> 2. <u>Place</u> 3-4. <u>Set</u> 3-4. <u>Locate</u>	Use "store" instead of "put away" for depositing or leaving in a specified place for future use.
	4. To lay or spread on or in.	4. Put sealant in the gap between the windshield and the aircraft structure.	1	1. <u>Apply</u>	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Qualify	To declare competent or adequate.	Qualify components which check out successfully.	-		
Raise	To move or cause to be moved from a lower to a higher position, to elevate.	Raise the spoiler control lever to the ARMED position.	1	2. Lift	
Read	To interpret the meaning of by visual observation.	Read the ammeter.	-		
Readjust	To adjust again; to move back to a specified condition; to bring back to an in-tolerance condition.	Readjust the voltage after performing an operational check of the system.	-		
Ready	To prepare for a maintenance activity.	Ready the Trunion Shaft Kit for removal of the M.G. shock strut.	3	1. Set up 2. Prepare	
Reassemble	To refit and secure together the parts of after they have been taken apart.	Reassemble component before installation on aircraft.	-		
Recall	To call back.	Recall parts which have not been modified.	-		
Recap	To cap again; to replace a covering; to reinstall a fitting for closing the end of a tube.	Recap the filler valve.	-		
Recapitulate	To repeat briefly.	Recapitulate the task sequence.	-		Use "repeat briefly".
Receive	To come into possession of; to get.	Receive supplies as they arrive.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Recognize	To perceive to be something previously known or designated.	A jet engine mechanic recognizes troubles through evaluation of engine operational checks.	-		
Recommend	To urge the acceptance or use of.	Recommend procedure changes where appropriate.	-		
Recondition	To renew; to bring or put back into good condition.	Recondition the pilot's and copilot's seats.	1	2. Renova-	
Reconnect	To rejoin or refasten that which has been separated.	Reconnect aft pistons to forward pistons.	-		
Record	To set down in writing.	Record maintenance time on appropriate form.	-		
Reduce	To cause to be diminished in strength, density or value.	Reduce pump flow.	-		
Refuel	To put fuel into the tanks of (an aircraft) again.	Refuel the system as outlined from applicable technical manuals.	-		
Regulate	To fix or adjust the time, amount or rate of; to exercise restraining or directing influence over.	Regulate electrical current generation and distribution.	1	2. Control	
Reinflate	To refill with a given amount of gas or air after deflation has occurred.	Reinflate tires to specified psi value.	-		
Reject	To refuse to have, use or take for some purpose.	Reject components which show excessive wear.	-		
Relay	To pass along by stages.	Relay the message to man D.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Release	1. To set free from an inactive or fixed position; to unfasten or detach interlocking parts. 2. To let go of. 3. To set free from restraint or confinement.	1. Release the parking brake. 2. Release tensioner handle. 3. Release pressure.	1 - -	2. Disengage 3. Unlock	
Relieve	To ease or set free of a burden, to partially release.	Relieve hydraulic pressure before working on a system.	-		
Remove	1. To perform operations necessary to take an equipment unit out of the next larger assembly or system. 2. To take off or eliminate. 3. To take or move away. 4. To take off devices for closing off the end of a tube.	1. a. Remove bleed air shutoff valves. b. Remove bolts from nuts. 2. Remove paint. 3. Remove jacks. 4. Remove caps (plugs) from all hydraulic lines.	- - 1	2. Unplug (unplug)	For screws, use "remove" rather than "unscrew".
Renovate	To renew; to bring or put back into good condition.	Renovate the pilot's and copilot's seats.	2	1. <u>Recondition</u>	
Repair	To restore damaged, wornout or malfunctioning equipment to a serviceable, usable or operable condition.	Repair engine by replacing parts and removing defects.	1		Repair includes replacement, overhaul and reworking of constituent parts or materials.
Repeat	To make, do or perform again.	If keys do not engage lugs, remove wheel assembly and repeat procedure.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Replace	1. To restore to a former place or position. 2. To substitute serviceable equipment for malfunctioning, wornout or damaged equipment.	1. Replace covers on jacks. 2. Replace the switch contact points.	1 1	2. Change	
Replenish	To fill or build up again.	Replenish drinking water when supply runs low.	-		
Report	To describe as being in a specified state. To make known, to; to give notice or report the occurrence of.	Report when ready. Report to man B that the brakes have been set.	1 1	2. Inform 3. Notify 4. Advise 5. Communicate to	
Repressurize	To reapply, pressure within by filling with gas or liquid after pressure has been released.	Repressurize the utility hydraulic system.	-		
Request	To ask for.	Request further information if necessary.	-		
Reset	To put back into a desired position, adjustment or condition.	Reset the field after performing an operational check of the generator.	-		
Resolve	To clear up or find an answer to; to reach a decision about.	Resolve the inconsistency before proceeding with maintenance activity.	-		
Restore	To bring back or put back into a former or original state.	Restore hydraulic pressure.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. SYNONYMS BY ORDER RANK OR PREFERENCE		NOTES
Retard	To manipulate so as to hold back or slow down, to hold back or slow down.	Retard the throttle.	-		
Retract	To draw up against or into the aircraft.	Retract the landing gear.	-		
Return	To bring, send or put back to a former or proper place.	Return the horizontal stabilizer to the neutral position.	-		
Review	To examine again; to go over or examine critically or deliberately.	Review procedures which have not been performed for more than two months.	-		
Rework	To reprocess for further use; to revise.	Rework the report forms.	-		
Rig	To assemble, adjust and align the major components of an aircraft (i.e., airfoils or other surfaces); to fit out (an aircraft) with control cables, bracing cables, pulleys, turnbuckles, etc.	Rig and adjust the mechanical linkage in the flight control system.	-		
Rinse	To cleanse (as from soap used in washing) by clear water.	Rinse the battery after cleaning it with soda water solution.	-		
Rope off	To partition, separate or divide by a rope (i.e., a large stout cord of strands of fibers or wire twisted or braided together).	Clear and rope off an area around the aircraft and post warning signs.	-		
Rotate	To cause to revolve about an axis or center.	Rotate the door handle counter clockwise until catches retract.	1	2. Turn	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Route	to send by a selected course of travel; to divert in a specified direction.	Route the memo to all affected personnel.	-		
Rub	To move along the surface of a body with pressure.	Rub hands around connections.	-		
Safeguard	To provide a technical contrivance to prevent accident; to comply with precautionary measures or stipulation.	Safeguard technical manuals.	-		
Safety	1. To secure an aircraft part against loosening from vibration. 2. To use safety wire to make an aircraft component fast or safe or secure against loosening from vibration. 3. To use a cotter pin to make an aircraft component fast or safe or secure against loosening from vibration.	1. Safety the lock nut on the relief valve. 2. Safety the bolts with wire.	3	1. Safety wire 2. Secure (with wire) 4. Install (with wire)	
Safety wire	To use safety wire to make an aircraft component fast or safe or secure against loosening from vibration.	Safety the bolt with a cotter pin.	3	1. Secure 2. Install	
Salvage	To rescue or save (as from discard, wreckage or ruin).	Salvage fuel which is drained from tanks.	1	2. Secure (with wire) 3. Safety 4. Install (with wire)	
Scan	To make a wide, sweeping search of; to look through or over hastily.	Scan the flight engineer's panels before beginning maintenance activity.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Schedule	To appoint, assign or designate for a fixed future time; to make a timetable of.	Schedule maintenance activities for the day.	-		
Screw	1. To attach, fasten or close by means of a screw. 2. To attach by means of a twisting motion in the proper direction. 3. To attach screws by means of a twisting motion in the proper direction.	1. Screw the ram safety lock to the ram. 2. Screw in jack pad. 3. Screw in twelve screws around cover.	- - 2		
Scrub	To clean with hard rubbing.	Scrub all metal parts with a white powder deposit on them.	-		
Secure	1. To make fast or safe. 2. To safety (with safety wire or cotter pin) to make aircraft component fast or safe or to keep it from loosening during vibration.	1. Load and secure components on trucks. 2. a. Secure bolts with safety wire. b. Secure the bolt with a cotter pin. Select a battery cell and insert hydrometer nozzle in the cell.	- 2 1	1. <u>Safety wire</u> 3. <u>Safety</u> 4. Install (with wire) 2. Install 3. Safety	
Select	To take by preference or fitness from a number or group, to pick out, to choose.		-		



VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Service	To perform such operations as cleanup, lubrication and replenishment to prepare for use.	Service each battery cell to only 3/8 inch above the plates.	-		
Set	1. To put a switch, pointer or knob into a given position; to put equipment into a given adjustment, condition or mode. 2. To put or place in a desired orientation or location.	1. Set PWR switch to ON.  2. Set the test equipment so that it can be seen by both technicians.	-  3-4	  1. Position 2. Place 3-4. Locate 5. Put	
Set up	To prepare or make ready for a maintenance activity.	Set up the Trunion Shaft Kit for removal of the MLC shock strut.	2	1. Prepare 3. Ready	
Shake	To move or cause to move to and fro in a quick, jerky manner.	Shake the container so that the paint will be well mixed.	-		
Shut down	To perform operations necessary to cause an equipment to cease or suspend operation.	Shut down the air conditioning.	1	2. Stop	
Signal	To notify or communicate by signals (i.e., a prearranged sign, notice or symbol conveying a command, warning, direction or other message).	Signal the pilot to move the aircraft to the left.	-		
Simulate	To give the appearance or affect of.	Simulate doppler radar signals.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Slide	To cause to move in a smooth manner over a surface.	Slide the stand in close enough to do the work.	-		
Specify	To name or state explicitly or in detail.	Specify the manufacturer's number of the multimeter.	-		
Spill	To cause or allow to fall, flow or run out.	Be careful not to spill battery acid on clothing, hands.	-		
Spin	To cause to revolve rapidly.	Spin wheel by hand until a bearing drag is noticed.	-		
Spray	To apply with a device which disperses a jet of finely divided liquid.	Spray the fuselage and tail sections moving from center to ends.	-		
Start	To perform actions necessary to set into operation, to set going, to begin.	Start the powered AGE.	1	2. Initiate 3. Originate	
Stay	To remain, to continue in a place.	Stay away from the danger area.	1	2. Keep	
Stimulate	To excite to activity or greater activity.	Stimulate flow by warming the lines.	-		
Stop	To perform actions necessary to cause an equipment to cease or suspend operation.	Stop the air conditioning.	2	1. <u>Shut down</u>	
Store	To deposit or leave in a specified place for future use.	Store the wheel covers after maintenance activity is completed.	1	2. Stow 3. Put away	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Stow	To deposit or leave in a specified place for future use.	Stow the wheel covers after maintenance activity is completed.	2	1. Store 3. Put away	
Strike	To deliver or aim a blow or thrust, to hit.	Strike the designated spot with a hammer	-		
Submit	To make available, to offer.	Submit request for modification of procedures.	-		
Suggest	To propose as desirable or fitting; to offer for consideration.	Suggest any changes which might be helpful.	-		
Superintend	To oversee; to have or exercise the charge of.	Superintend the repair of the engines.	2	1. <u>Supervise</u> .	
Supervise	To oversee; to have or exercise the charge of.	Supervise the repair of the engines.	1	2. Superintend	
Support	To hold up or provide a foundation or props for.	Support the elevator at both ends.	-		
Survey	To examine comprehensively as to condition, situation or value.	Survey entire aircraft surface.	-		
Synchronize	To cause to happen at the same time.	Synchronize the activities of man A and man B.	-		
Tabulate	To set up in the form of a table (with rows and columns); to compute by means of a table.	Tabulate maintenance times for each occurrence of the various maintenance activities.	-		

1. CHRS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Tag	To provide with an identifying or indicating symbol with or as if with a tag (i.e., a cardboard, plastic or metal marker used for identification or classification); to label.	Tag each hydraulic line before removing it.	1	2. Attach a tag. 3. Mark 4. Connect a tag to	
Take	1. To get into or carry in one's hands or one's possession. 2. To get or find out by observation or special procedures.	1. Take supplies out to the aircraft. 2. Take a reading on the outside circle of the lensiometer.	- 1		
Tap	To strike lightly.	Tap the eye of the cotter pin to seat it.	-		
Test	To perform specified operations to verify operational readiness of a component, system or subsystem.	Test the true airspeed indicator.	2	1. <u>Checkout</u>	
Throw	To move (a switch) so as to make or break a connection.	Throw switch to ON position.	-		Use "set" for all switches.
Tie	To fasten, attach or close by means of a line or cord.	Tie mooring ropes to tie points under wing and on nose.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Tighten	1. To perform necessary operations to fix more firmly in place. 2. To apply a specified amount of force to produce a rotation or twisting motion to fix more firmly in place.	1. Tighten all screws. 2. Tighten the nut to a torque value of 1000 inch-pounds.	2	1. <u>Torque</u>	
Tilt	To cause to slope, lean or incline.	Tilt maintenance stand backwards until wheels contact the ground.	-		
Torque	To apply a specified amount of force to produce a rotation or twisting motion to fix more firmly in place.	Torque the nut to 1000 inch-pounds	1	2. Tighten	Torque (noun) = length of wrench handle times applied force.
Tow	To pull along (an aircraft) by means of a towing vehicle and tow bar.	Tow aircraft to the washrack.	-		
Trace	To follow or study out in detail or step by step.	Visually trace the wiring diagram.	-		
Transfer	To convey or cause to pass from one place to another.	Transfer fuel and oil from one place to another.	-	2-3. Transport 2-3. Transmit	
Transmit	1. To convey or cause to pass from one place to another.	1. Transmit fuel and oil from one place to another.	2-3	1. <u>Transfer</u> 2-3. Transport	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Transmit (cont)	2. To send out a signal by radio waves or wire.	2. Transmit message to control tower.	-		
Transport	1. To convey or cause to pass from one place to another. 2. To carry by hand or in a vehicle or hoist, or in a container, etc.	1. Transport fuel and oil from one tank to another. 2. Transport landing gear to shop on dolly.	2-3	1. <u>Transfer</u> 2-3. <u>transmit</u>	
Trim	1. To free of excess or extraneous matter by or as if by cutting. 2. To adjust (a jet engine) to compensate for wear.	1. Trim patch to fit. 2. Trim the No. 1 engine.	-		
Troubleshoot	To localize and isolate the source of a malfunction or break down.	Troubleshoot the landing gear control circuit.	-		
Tune	To adjust for precise functioning.	Tune the transmitter for maximum output.	-		
Turn	To cause to revolve about an axis or center.	Turn the door handle counter clockwise until latches retract.	2	1. <u>Rotate</u>	
Turn off	To shut off or stop the flow of by or as if by moving a control to its OFF position.	Turn off power to the signal generator.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Turn on	To cause to flow or operate by or as if by moving a control to its ON position.	Turn on power to the signal generator.	-		
Uncap	To remove a device for closing off the end of a tube with a male fitting.	Uncap and unplug all hydraulic lines.	2	1. <u>Remove caps</u>	
Unlock	To set free from an inactive or fixed position, to unfasten, to detach interlocking parts.	Unlock the parking brake.	3	1. <u>Release</u> 2. <u>Disengage</u>	
Unplug	1. To detach or separate (an electrical device) from a service outlet. 2. To remove a device for closing off the end of a tube with female fittings.	1. Unplug the soldering iron. 2. Unplug and uncap all hydraulic lines.	1 2	2. <u>Disconnect</u> 1. <u>Remove plugs</u>	
Unscrew	1. To loosen or withdraw by turning in the proper direction. 2. To draw the screws from.	1. Unscrew the jack pad. 2. Unscrew twelve screws around cover.	- 2	1. <u>Remove</u>	
Unwind	To cause to uncoil or unroll.	Unwind hoses from hose rack.	-		
Use	To put into action or service; to avail oneself of; to carry out a purpose or action by means of.	Use only antimagnetic fasteners.	1	2. <u>Utilize</u> 3. <u>Employ</u>	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OR PREFERENCE	NOTES
Utilize	To put into action or service; to avail oneself of; to carry out a purpose or action by means of.	Utilize only antimagnetic fasteners.	2	1. <u>Use</u> 3. Employ	
Verify	1. To confirm or establish that a proper condition exists. 2. To establish the truth or accuracy of.	1. Verify that the light is off. 2. Verify the readings before recording them. Wait five minutes before performing the next task.	2 - -	1. <u>Be sure</u> 3. Check 4. Determine 5. Ascertain	
Wait	To suspend activity in a sequence of activities until a given condition occurs or a given time has elapsed.		-		
Wash	To cleanse by or as if by the action of liquid; to remove (dirt) by rubbing or drenching with liquid.	Wash the battery with a cleaning solution and a stiff brush.	-		
Watch	To visually take note of, to pay attention to in order to check on action or change.	Watch the indicator for changes in airspeed.	2	1. <u>Observe</u> 3. Monitor	
Wire	To provide with wire, to use wire on.	Wire the circuit.	1	2. Install wiring	
Withdraw	To take back, away, or out	Withdraw the bar magnet from the center of the coil.	-		
Wrap	To wind, coil or twine as to encircle or cover something.	Wrap the wire around the terminal.	-		



VERBS	DEFINITIONS	EXAMPLES	PREF. RANK SYNONYMS BY ORDER OR PREFERENCE	NOTES
Zero	To bring to a desired level or null position.	Zero the protractor to the surface.	-	

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